Circular household waste management: A study about the transition from a linear to a circular waste management system and the potential for commercial opportunities in Europe through the example of Brussels Capital Region

Geronimo Piñeiro Aramburu

152118073

Dissertation written under the supervision of Nuno Moreira Cruz

Dissertation submitted in partial fulfilment of requirements for the MSc in Business, at the Universidade Católica Portuguesa, June 2nd, 2021.

Acknowledgment

First, I would like to thank the supervisor of this dissertation, professor Nuno Moreira Cruz. You inspired me, as well as several other students that followed your research laboratory, to put our knowledge and energy towards building a better future for everyone. You always manage to put time aside for me and encouraged me to follow a subject that I was passionate about. Professors such as yourself are rare.

This research would not have been possible without the support of my parents, I simply can not believe how lucky and privileged I am to have both of you. You taught me to be curious, to never settle and showed me that it's possible to learn from every situation. I will cherish and carry these lessons for the rest of my life. I love you very much.

I also would like to thank every participant that contributed to this thesis dissertation. Each one of you made this research possible despite these hard times. Organizing interviews during a global pandemic is not easy but you made it work and I will always be grateful for that. Your enthusiasm and passion for the subject was infectious and I hope that I'll be able to follow your steps in the industry.

Delfina, you are not only a great companion but a very compassionate human being, which makes you very special. These last months would have been very different if it wasn't for you. I hope I will be able to help you as you helped me.

Abstract

As the worldwide population increases, along with consumption trends, our current global waste generation has become a real environmental and health concern. The way governments, cities and municipalities decide to manage solid waste has a major impact on our society, our economies and the earth's climate.

The subject of municipal solid waste management is a complex and multilevel issue that needs to be extensively analyzed if ever to be improved. Nevertheless, solutions are available as the EU aims to evolve within the spectrum of a Circular Economy to tackle this predicament. By doing so, European countries are inevitably shifting their behavior from a linear model, consuming and disposing products without any regards for the environmental impact, to a circular approach, where waste streams are reintroduced inside the economy and appreciated as valuable materials. Thus, there will be lucrative commercial opportunities for the entire waste management circle in the years to come. The European Environment Agency estimates value generation between 245 billion and 604 billion euros by 2030 for this industry.

The aim of this paper is to, first, highlight the main characteristics of a circular waste management system. Secondly, it will consider how necessary are Waste to Energy incineration technologies when it comes to residual waste treatment from household. Finally, by looking at the example of Brussels Capital Region, this paper will explore upcoming commercial opportunities which promote such a circular scheme.

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Keywords: Brussels Capital Region, Circular Economy, Circular Waste Management System, Integrated Solid Waste Management, Municipal Solid Waste, Waste to Energy.

Resumo

À medida que a população mundial aumenta, assim com as tendências de consumo, a nossa geração global atual de resíduos tornou-se uma verdadeira preocupação ambiental e de saúde. A forma de como os governos, cidades e municípios decidem gerir os resíduos sólidos tem um grande impacto na nossa sociedade, nas nossas economias e nas alterações climáticas.

O tema da gestão de resíduos sólidos urbanos é uma questão complexa e precisa de ser amplamente analisada se almejarmos resolvê-la. Não obstante, as soluções estão disponíveis uma vez que a UE quer evoluir dentro de uma Economia Circular para enfrentar esta situação. Ao fazê-lo, os países europeus estão a mudar o seus comportamentos de um modelo linear, consumindo e eliminando produtos sem consideração pelo impacto ambiental, para uma visão circular, onde os fluxos de resíduos são reintroduzidos dentro da economia e apreciados como materiais valiosos. É por isso que haverá oportunidades comerciais lucrativas na gestão de resíduos nos próximos anos. A Agência Europeia do Ambiente estima uma geração entre 245 mil milhões e 604 mil milhões de euros até 2030 nesta indústria.

O objetivo desta dissertação é, em primeiro lugar, destacar as principais características de um sistema circular de gestão de resíduos. Em segundo lugar, irá a estudar a necessidade das tecnologias de incineração de resíduos com recuperação de energia para o tratamento de resíduos residuais domésticos. Finalmente, através de o exemplo da Região de Bruxelas-Capital, este documento irá explorar as futuras oportunidades comerciais que promovem um sistema circular.

Autor: Geronimo Piñeiro Aramburu

Titulo: Gestão circular de resíduos domésticos: Um estudo sobre a transição de um sistema de gestão de resíduos linear para um circular e o potencial de oportunidades comerciais na Europa através do exemplo da Região de Bruxelas-Capital

Palavras-chave: Região de Bruxelas Capital, Economia Circular, Sistema de Gestão de Resíduos Circulares, Gestão Integrada de Resíduos Sólidos, Resíduos Sólidos Municipais, Resíduos para Energia.

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Abbreviations

BCR	Brussels Capital Region
CE	Circular Economy
CEWEP	Confederation of European Waste to Energy Plants
CWMS	Circular Waste Management System
EU	European Union
GHG	Greenhouse Gases
ISWM	Integrated Solid Waste Management
MSW	Municipal Solid Waste
WEEE	Waste Electrical and Electronic Equipment
WtE	Waste to Energy

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I. Introduction

This research aims to highlight the main characteristics of a circular waste management system. Then, reflect on the necessity of Waste to Energy incineration technologies when it comes to residual waste treatment from household. And finally, through the example of Brussels Capital Region, this paper will explore upcoming commercial opportunities which promote such a circular scheme.

As the worldwide population increases, along with consumption trends, our current global waste generation has become a real environmental and health concern (Vitorino & al., 2016). The way governments, cities and municipalities decide to manage solid waste has a major impact on our society, our economies and the earth's climate. The Global Waste Management Outlook written by the UN Environment Programme and the International Solid Waste Association predicts a global Municipal-Solid-Waste (MSW) generation reaching up to 2 billion tones per year (Global Waste Management Outlook UNEP, 2015). Municipal-Solid-Waste, predominantly household waste, is said to be one of the major waste streams in the world, corresponding to approximately 24% (Global Waste Management Outlook UNEP, 2015). As a part of an increasing concern for the European Union (EU) to accelerate the transition towards a circular economy (Circular Economy EU Action Plan, 2020), waste management has become one of the main points of focus in the EU Circular Economy Action Plan of 2020 (Closing the loop EU Action Plan, 2015). In 2008, the European Union published the Waste Framework, Directive 2008/98/EC, putting in place basic concepts and definitions of waste management, which included defining the different types of waste, considering what constituted recycling and recovering, but also setting crucial principles and objectives for all EU Member States (Directive 2008/98/EC, 2008). In one section, it presented the Lansink ladder, a hierarchy specifying priorities when it comes to waste prevention and management legislation for EU countries (Directive 2008/98/EC, 2008). In another, it laid down targets for MSW management which instructed European countries to recycle at least 65% of household waste by 2035 and reduce their landfilling to a maximum of 10%.

This paper will only address household waste management, as industrial waste raises other types of issues and, thus, specific types of treatment non related to municipal waste. When looking around the spectrum of solutions regarding residual waste coming from households, there seems to be two main options: Incineration with energy recovery or landfilling. As the EU aims to minimize landfilling as much as possible in the future (Landfill of waste Directive EC, 1999), recycling and energy recovery technologies, also known as Waste to Energy (WtE)

technologies, present themselves as crucial tools to adopt a more sustainable waste management system. Though some view these technologies as complementary, others view them as contradicting and even counterproductive to the elaboration of a circular economy. On one side, such actors as the Confederation of European Waste to Energy Plants (CEWEP) argue that there will always be a necessity for waste incineration (CEWEP, 2015). On the other hand, associations such as Zero Waste Europe take a stance against waste incineration as a long-term solution given its environmental impact.

The subject of MSW management is a complex and multilevel issue that needs to be extensively analyzed if ever to be improved. Nevertheless, solutions are available as the EU aims to evolve within the spectrum of a Circular Economy to tackle this predicament. By doing so, European countries are inevitably shifting their behavior from a linear model, consuming and disposing products without any regards for the environmental impact, to a circular approach, where waste streams are reintroduced inside the economy and appreciated as valuable materials. Thus, there will be lucrative commercial opportunities for the entire waste management circle in the years to come. The European Environment Agency estimates value generation between 245 billion and 604 billion euros by 2030 for this industry (Circular economy in Europe, EEA Report No 2/2016, 2016).

The aim of this paper is to, first, highlight the main characteristics of a circular waste management system (CWMS). Secondly, it will consider how necessary are WtE incineration technologies when it comes to residual waste treatment from household. Finally, by looking at the example of Brussels Capital Region (BCR), this paper will explore upcoming commercial opportunities which promote such a circular scheme.

II. Literature Review

To define the circular treatment of waste, the United Nations Environmental Program (UNEP) uses the term of Integrated Solid Waste management. It refers to the "strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency" (Developing Integrated Solid Waste Management Plan UNEP, 2009). The main idea behind this concept goes hand in hand with the principles of a circular economy. The aim is to develop a system that reduces the use of virgin materials as much as possible, valorizing efficiently waste streams

(by reusing materials or through energy transformation) and thus ultimately reaching climate neutrality whilst ensuring a competitive economy.

Nevertheless, research such as J.K. Seadon's paper on Integrated Solid Waste Management (ISWM) explained the complexity behind the implementation of such a waste administration scheme in modern societies (Seadon, 2006). Historically, waste was conceptualized in a linear manner, meaning that it was produced without the possibility to re-integrate those materials in the economy once they served their purpose. This facilitated the way in which our societies manufactured and dealt with waste in general without considering the repercussions of such behavior. The implementation of ISWM implies the action and coordination of various stakeholders of modern societies: states, manufacturers, citizens and waste treatment facilities.

In view of the EU Circular Economy Action Plan of 2020 and the European Union Waste Framework, Directive 2008/98/EC on Waste, research by Malinauskaite & al. analyzed the legitimacy of WtE technologies in this context (Malinauskaite J & al., 2017). Waste valorization comes at a certain environmental cost, as studied in Tabasova & al. (2012) or even Pavlas & al. (2009), and rigorous standards need to be adopted if ever to be actually considered as contributing positively to a CWMS. In certain cases, these policies are not well implemented and WtE plants can cause more harm to the environment while also undermining the development of recycling initiatives, as analyzed in A Luthra research (Luthra, 2017). The Directive 2008/98/EC defines Waste as "any substance or object which the holder discards or intends or is required to discard". Municipal solid waste represents around 24% of total waste generated in the world yet it is considered to be one of the most polluting categories of waste. This is due to the fact that most of them are made out of a composition of mixed materials, which makes it hard to reintroduce in the economy (Global Waste Management Outlook UNEP, 2015). Nevertheless, it is also the category with the highest potential for environmental improvement through better management (Towards a circular economy – Waste management in the EU, 2017).

A. Global contextualization: The China Ban

When analyzing global waste production, one must note that China was the biggest importer of solid waste, particularly plastic residuals and used papers, for the last 30 years. Since the 1990's, China has imported a combined total of 45% of the world's plastic waste intended for recycling (Tran, 2020). Moreover, from 1988 to 2016, it is said that the EU would

rank first as the largest exporter of plastic waste in the world (Brooks, 2018), with waste exportation from Europe to China reaching a peak 10.1 million tones in 2009 (EU Waste Import Export Eurostat, 2020).

Since the beginning of the 2000's, there has been an increase in the trade imbalances between China and the EU. The quantities of containers sent to Europe were far more numerous than what the EU sent back to Asia. This event was noticeable all across occidental countries and resulted in heavy losses for shipping companies that had to reposition empty containers due to the lack of products to export back. To balance these costs, countries decided to fill these empty containers with waste so they would not be sent back to China empty. It is estimated that plastic waste accounted for up to 68% of China's total sea-trade (Bernard, 2014). This figure includes the totality of import and export of virgin, recycled and recyclable plastic.

As such, China decided to tighten its regulation on waste importation through two restrictive programs, Operation Green Fence in 2013 and National Sword in 2017. These directives had an extensive impact on recycling facilities all across the world. The Asian giant attempted to improve its environmental and health regulations, in light of current concerns around the contamination of plastic waste, which resulted in the total ban of 24 types of solid waste by 2017. From this situation, two possible scenarios are foreseeable: On one hand, this waste could be diverted to new foreign waste importers, such as Malaysia or India. On the other hand, and most probably, recent international waste trade and environmental regulations will present an opportunity to develop the recycling industry within Europe's borders. Thus, presenting commercial opportunities in the European waste treatment industry. Countries such as Germany and the Netherlands have already started importing waste as their sophisticated waste management systems can absorb and valorize foreign waste streams (Brooks, 2018).

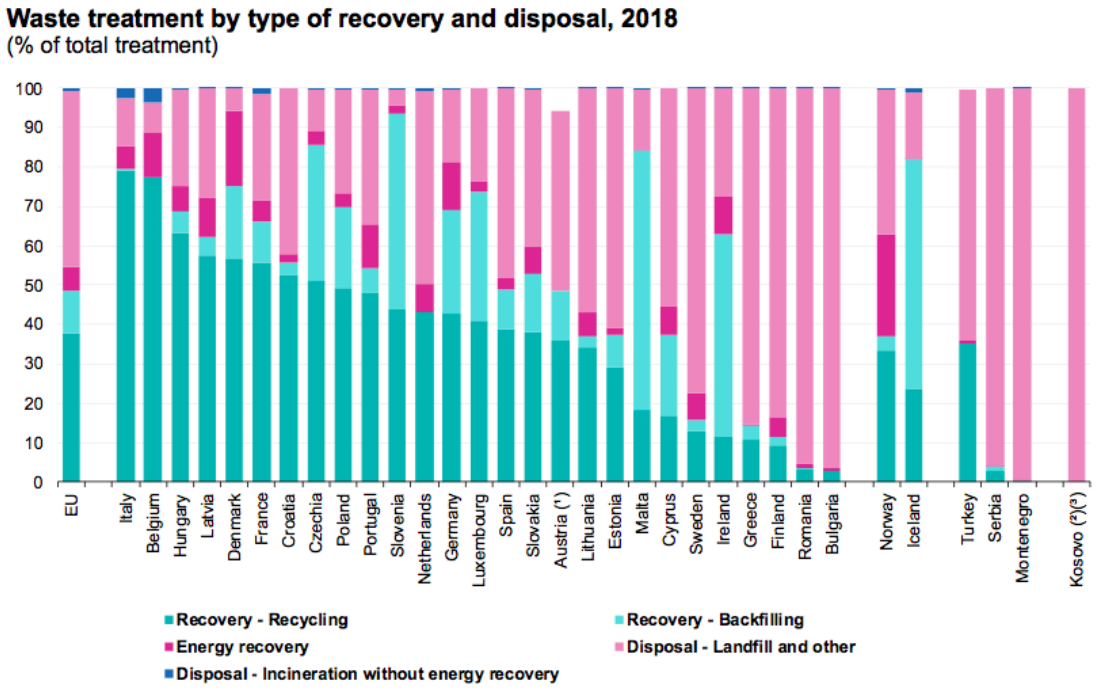
B. European Union contextualization: Waste generation, treatments and targets

There are approximately 512 million inhabitants in the EU and, in 2015, the amount of waste generated per capita was estimated to be around 477 kg per year, "after one year of generation the EU municipal solid waste would cover Malta (316 km2) with a layer almost 2 meters high" (Malinauskaite, 2017). These numbers have never been so high despite household waste only accounting for approximately 10% of the entire waste generation in Europe (Towards a circular economy – Waste management in the EU, 2017). It said that this waste stream has the biggest potential for management improvement. The majority of EU states will

have to make important efforts to meet the targets presented by the European commission, especially when it comes to increasing recycling and reducing landfilling (Dri, 2018).

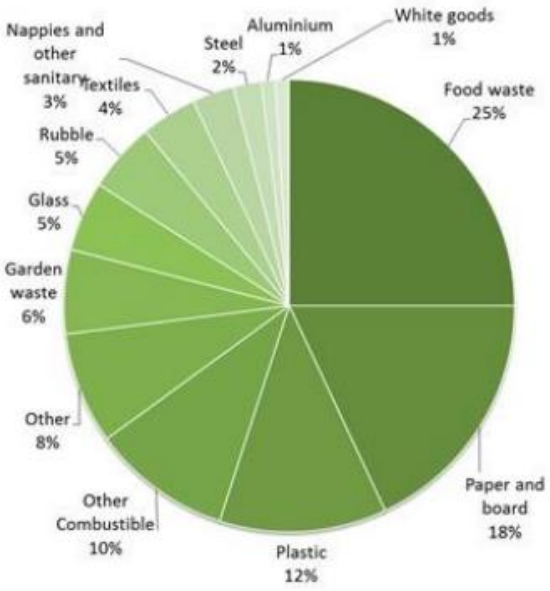
As a part of the European Green Deal, objectives were set to make Europe a more resource-efficient and sustainable economy:

- 65% of household waste has to be recycled and sorted in a way to be ready to be reused by 2035.
- By 2035, EU-28 countries will only be able to dispose 10% of MSW in landfills and 0% of separately collected waste.
- 55% of plastic waste coming from household have to be recycled by 2030.
- 85% of WEEE generated in EU has to be recycled and 65% for the ones coming outside of the frontier by 2030.
- Recycling of Bio-waste has been targeted at 65% by 2035.
- A tax of 0.8€ per kilogram (800€ per tones) has been set for non-recyclable plastic emission.



Source: Eurostat (env_wastrt)

Composition of MSW in Europe



Source : Zero Waste Europe 2015

C. Brussels contextualization

Belgium has rigorous regulations regarding separated waste collection, recycling, landfilling and waste incineration of MSW, making it one of the Europe's frontrunners in waste management. Belgium is often considered as one the European countries with the highest rates of municipal solid waste recycling, reaching up to 54% in 2017 (EEA Recycling Rates, 2018). In 2017, inhabitants of Brussels produced an average of 420 kilograms of solid waste per year (Bruxelles Propreté - Rapport Annuel, 2017). Nevertheless, according to Bruxelles Propreté, the agency in charge of municipal waste collection for the Brussels Capital Region (BCR), only 37% of household residues are recycled (Municipal Waste Management in Belgium, 2013). The national average increases when considering the figures of BCR's neighboring regions, Flanders and Wallonia, which reached 65% and 63,6% respectively in 2014 (IBSA Focus 5, 2014). The lower amount of recycled waste in Belgium's capital is mostly explained by the lack of recycling infrastructure resulting from high urban density (Municipal Waste Management in Belgium, 2013), a recurrent challenge for European capitals. Nevertheless, the recent mandatory household waste separation in household should help improve BCR recycling rate.

Since the beginning of the 2000's, Belgium adopted different regulations to improve its waste management performance. It increased its landfill taxes which drove the levels of landfilling down from 11 % in 2001 to 1.2 % in 2010. Furthermore, the collection of sorted

waste in households led to more homogenous waste streams and ultimately the implementation of a stronger recycling system (CEWEP Belgium Report, 2016). When analyzing the environmental performance of the industry from that period (through Greenhouse gases (GHG) emission), national policy efforts regarding landfilling and recycling, led to important environmental benefits through the use of waste as a resource (Municipal Waste Management in Belgium, 2013).

D. Important definitions

In order to correctly understand the concepts and notions presented in the research, it is important that the reader share the same definitions in which they will be employed. As such, given that this study addresses the concept of circular waste management inside Europe's transition towards more efficient management of MSW, the definition below will be inspired by the ones provided by the European Commission Directive 2008/98/EC Waste Framework Directive.

- **Circular economy**: Economic theory aiming to reduce as much as possible the exploitation of resources by minimizing overall waste generation and reintroducing assets into the production cycle once they have reached their purpose. Thus, ultimately reaching climate neutrality through efficient resource and energy management whilst ensuring a competitive economy.
- **Lansink ladder** or **Waste Hierarchy**: This concept is the waste hierarchy that every European country has to apply as a priority order regarding waste prevention and management legislation and policies:
    - Prevention
    - Reuse
    - Recycling
    - Recovery
    - Disposal
- **Municipal Solid Waste**: Mixed waste and separately collected waste from households.

- **Municipal Bio-waste**: Biodegradable and biogenic waste coming from garden or kitchen households.
- **Residual waste**: Material left after any waste treatment process.
- **Waste to Energy incineration**: Waste treatment technique involving the incineration of waste in order to create energy such as electricity and heat through water evaporation. Such tools also allow to reduce waste volume and recuperated some materials in the process.

III. Research intention

The aim of this paper is to contribute to the literature on circular waste management, and residual waste treatment methods. Following the literature review, contextualization and definitions above, the theoretical characteristic of circular MSW management will be analyzed through the insight of various experts in the industry, as well as the legitimacy of WtE incineration technologies in CWMS. Consequently, the results aim to showcase business opportunities geared towards more circular schemes of waste management inside dense and populated urban areas like BCR. In the next section, the academic relevance of this research will be elaborated, followed by the presentation of the problem statement and research questions.

A. Academic & commercial relevance

Belgium is one of the European countries with the highest MSW recycling rates, with more than half recycled (EUROSTAT Recycling rate of Municipal Waste, 2020). Brussels Capital Region is a dense and populated city which practices robust waste sorting for households as it looks to reach the goal of recycling 65% of household waste by 2035. Nevertheless, highly dense urban capitals such as Brussels are limited by their space, which prevents them to have recycling facilities in the region. Therefore, a WtE incinerator was built in the center of the city as a way to valorize MSW and reduce the volume of waste. Brussels can be seen as an accurate depiction of the challenges and questions to come when foreseeing a circular management of waste for urban areas. Having a high concentration of citizen organizations, European lobbies and entrepreneurs of the waste treatment industry, this research could be relevant when it comes

to framing an accurate circular MSW management scheme and, thus, examining potential business opportunities for other European capitals.

Furthermore, qualitative research showcasing opinions and insights from experts on the mater are surprisingly scarce amongst the academic literature. Analysis based on the transcription of different point of views should be encouraged amongst scholars as this topic requires the coordination of several sectors of the industry if ever to be solve. It is by understanding these different subjective perspectives that we can comprehend the broader reality. Moreover, insight from professionals ranging from prevention all the way to waste disposal could highlight actual practical commercial opportunities through academic research.

B. Problem statement & research questions

Within the spectrum of circular economy, the **problem statement** of this research is defined as such: Given the EU's, and more specifically Belgium and its capital, intention to make its economy sustainable, how should the transition from a linear to a circular scheme of MSW be implemented and how does this shift present business opportunities all across this cycle. In this context, the point of view of several experts working on different steps of the industry were consulted. The literature review, and specifically the theories on circular MSW management made in chapter II served as a foundation for the research questions, which are as follows:

1° What are the main characteristics of Circular Waste Management System?

2° Are WtE incineration technologies inevitable for residual waste management coming from household in a Circular Waste Management System?

3° Where and what are the main business opportunities leading towards a more circular MSW system in Brussels Capital Region?

IV. Methodology

This section will highlight the methodology of the conducted study. In this context, the research method, a detailed transcription of the sample, the interview protocol and the data collection method will be showcased. Ultimately, the data treatment method will illustrate how the results were drawn, building the transition to the findings presented in the next chapter.

A. Research method

Given that the transition to a circular scheme of MSW has an impact on several sectors of the industry, a **qualitative research method** was chosen to provide a broad and detailed understanding of the subject. The subject of MSW management is a complex and multilevel issue that needs to be analyzed as an ensemble. As this research aim to study this problematic through the paradigm of the circular economy, insight from experts present all across the cycle were required. Qualitative research allowed practical perceptions from professionals on this subject. Quantitative data research method could not have showcased the differences of opinions or even the intricacy that lies beyond this topic. Having multiple different, subjective, point of views for each of these questions was crucial to distinguish the broader picture. Long format discussions with qualified experts granted this multilevel comprehension that was intended from the beginning.

B. Sample method & description of the participants

The **purposive sampling method** was chosen as the framework of this research required the opinion of experts on several aspect of the subject. As such, participants were chosen deliberately, not randomly. Seven waste treatment experts ranging from various sectors of the industry answered the same six questions regarding circular household waste management and solutions.

As the research aspires to bring a multilevel comprehension of CWMS, it is important to describe with more details who were the participants of this paper. These contributors were chosen deliberately to present opinions of actual authorities in terms of waste prevention, recyclability, energy recovery, disposal and collection. Furthermore, a detailed description allows a better comprehension of the results found on the next chapter.

- **Alain Maubert**
    - Participant description: Director and entrepreneur in the field of plastic recycling solutions. He created several recycling facilities and he's at the front of leading treatment technology solutions for plastic polymers.
    - Company & Location: Micropolymers & Atmos. France & Belgium.
    - Linkedin: https://www.linkedin.com/in/alain-maubert-0908426a/

- **Georges Dumbruch**
    - Participant description: Former director of the Brussels Waste to Energy incineration plant. He was responsible of managing Waste to Energy solutions for municipal, private and residual waste for the entire Brussels Capital Region.
    - Company & Location: Bruxelles-Energie Waste to Energy plant. Brussels, Belgium
    - Linkedin: https://www.linkedin.com/in/georges-dumbruch-a955b876/

- **Gerald Valay**
    - Participant description: Director of *Lanfranchi Environnement*, treatment and disposal of non-hazardous waste. He is an expert on waste treatment and municipal solid waste solutions as he has been the director of multiple sorting and treatment facilities in different European and North African countries. Implementation of circular waste management has been at the core of his life work.
    - Company & Location: Lanfranchi Environnement. Viggianello, Corsica, France
    - Linkedin: https://www.linkedin.com/in/g%C3%A9rald-valay-14a25051/

- **Janek Vahk**
    - Participant description: Program Coordinator at *Zero Waste Europe*. Civic, social and political organization working towards the extinction of waste in the near future. Through the vision of circular economy, they work at the European level to implement more sustainable waste policy.
    - Company & Location : Zero Waste Europe. Brussels, Belgium.
    - Linkedin : https://www.linkedin.com/in/janek-v%C3%A4hk-00407332/

- **Maxime Pernal**
    - Participant description: Policy Officer at *Confederation of European Waste to Energy Plants CEWEP*. Association of the European operators of incineration with energy recovery plants. They contribute to European environmental and energy legislation that can affect Waste-to-Energy Plants.
    - Company & Location : CEWEP. Brussels, Belgium.
    - Linkedin: https://www.linkedin.com/in/maxime-pernal-ba390787/

- **Sofia Figuereido**
    - Participant description: Business development manager at *Veolia*. She is responsible for promoting Veolia's ecological transformation in waste and energy areas. She has been engaged in several waste-to-energy and recycling projects with one of the world leading companies in optimized resource management.
    - Company & Location : Veolia. Lisbon, Portugal.
    - Linkedin : https://www.linkedin.com/in/sofia-figueiredo-1a935419/

- **Wouter Achten**
    - Participant description: Professor and researcher at the *University of Brussels ULB*. His work specializes on the analysis of economic and environmental potential for waste streams for a transition towards a circular economy model of materials' management in the Brussels Capital Region.
    - University & Location : Université Libre de Bruxelles. Brussels, Belgium
    - Linkedin : https://www.linkedin.com/in/wouterachten/

C. Interview protocol

The research was led through semi-structured, one on one, recorded interviews consisting of 6 specific questions with the possibility, for the interviewees, to pursue an idea with more detail. Therefore, an interview questionnaire was created so that each of the participant answered the same six questions regarding circular household waste management and solutions.

D. Data Collection Method

The **content analysis treatment** method was chosen to manipulate the data. First, the most relevant parts of the interviewees' answers were selected for each question and inputted into a Matrix table, through an excel spread sheet. The Matrix analysis table displays the most relevant parts of the participants' answers for each question. Each segment was transcribed in the exact same way the participant answered and was then indexed with the frame of time in which the sentence occurred during the discussion.

Once all the most important quotations from the participants were grouped, pattern of answers for each question were noticeable. Meaning that the interviewees had common answers even though the participants weren't coordinated. Relevant responses were established as the ones that were repeated the most by participants. By observing the recurrence of specific keywords or similar usage of phrasing, each answer type was transcribed into a 'code'. Subsequently, it was possible to establish a numerical value of the most used answers, which allowed to draw conclusions for the analysis. The Matrix table and the Matrix table results are available in the Appendix section at the end of this paper.

Thus, each answer could then be transcribed into a 'code' and in turn, these codes were added to the table below. For each question there is a numerical result for every time a specific code had been mentioned from one of the participants, those results would be shown and commented later on. This way, it was possible to establish which answers had been the most frequently used. Finally, questions were subdivided into 3 different "Themes" which allowed the analysis to answer the three research questions below more broadly:

- Characteristics of a circular Waste Management System
- Role and impact of WtE incineration for residual waste from households in a CWMS
- Business opportunities leading towards a more circular Municipal Solid Waste treatment

Interview Questions	Answer types	Themes
1° In your opinion, what are the main characteristics of a circular waste management system?	1° Sustainable design 2° Thorough sorting and collecting 3° Legislation: Market Incentives & sanctions 4° Preserve resource & Reduce waste 5° Bring awareness to people 6° Exhaustive waste treatment channels	Characteristics of a circular Waste Management System
2° When it comes to a circular Municipal Solid Waste management system, do you believe Waste to Energy incineration is inevitable?	1° Yes, strongly agree 2° Yes, moderately agree 3° No, don't agree	Role and impact of WtE incineration technologies for residual waste from households in circular waste management system
3° According to you, can WtE incineration technology be considered as a renewable source of energy?	1° Yes, strongly agree 2° Yes, moderately agree 3° No, don't agree	
4° Do you believe that there is an influence of the development of Incineration technologies on the expansion of Recycling Technologies?	1° Yes, there is an influence 2° No, they go hand in hand	
5° Taking into consideration the Lensink Ladder, otherwise known as the "waste hierarchy", in which steps do you believe there are the most business opportunities?	1° Prevention 2° Reuse 3° Recycling 4° Recovery 5° Disposal	Business opportunities leading towards a more circular Municipal Solid Waste treatment
6° In your opinion, what do you think might be the main technological, logistical and business related opportunities when it comes to improving waste management systems towards more circular schemes? (e.g. the development of specific material treatment plants, household waste sorting, different waste collection systems…) And more specifically for the Brussels Capital Region?	1° Organic Waste treatment 2° Plastic treatment 3° Waste collecting solutions 4° Sorting technologies and facilities 5° E-waste treatment 6° Sustainable design 7° Deposit Return Scheme Development 8° Raise awareness 9° Reuse/Repair initiatives	

Table 1: *Interview Questions & Themes*

V. Results & discussion

1. What are the main characteristics of Circular Waste Management System?

When this question was asked to the participants, six different features were noticed when defining what are the principal characteristics of such a such a system. The answers will be presented by order of importance.

1° In your opinion, what are the main characteristics of a circular waste management system?		
Answer Type	Participants	**Total**
1° Sustainable design	*Sofia, Alain, Gérald, Georges, Janek, Maxime, Wouter*	**7**
2° Thorough sorting and collecting	*Sofia, Gérald, Georges, Janek, Maxime, Wouter*	**6**
3° Legislation: Market Incentives & sanctions	*Sofia, Alain, Gérald, Janek, Georges, Maxime, Wouter*	**7**
4° Preserve resources & Reduce waste	*Sofia, Gérald, Janek, Wouter*	**4**
5° Raising awareness	*Sofia, Georges, Janek, Maxime, Wouter*	**5**
6° Exhaustive waste treatment channels	*Alain, Gérald, Janek, Maxime, Wouter*	**5**

Table 2: *Q°1 In your opinion, what are the main characteristics of a circular waste management system? (RESULTS)*

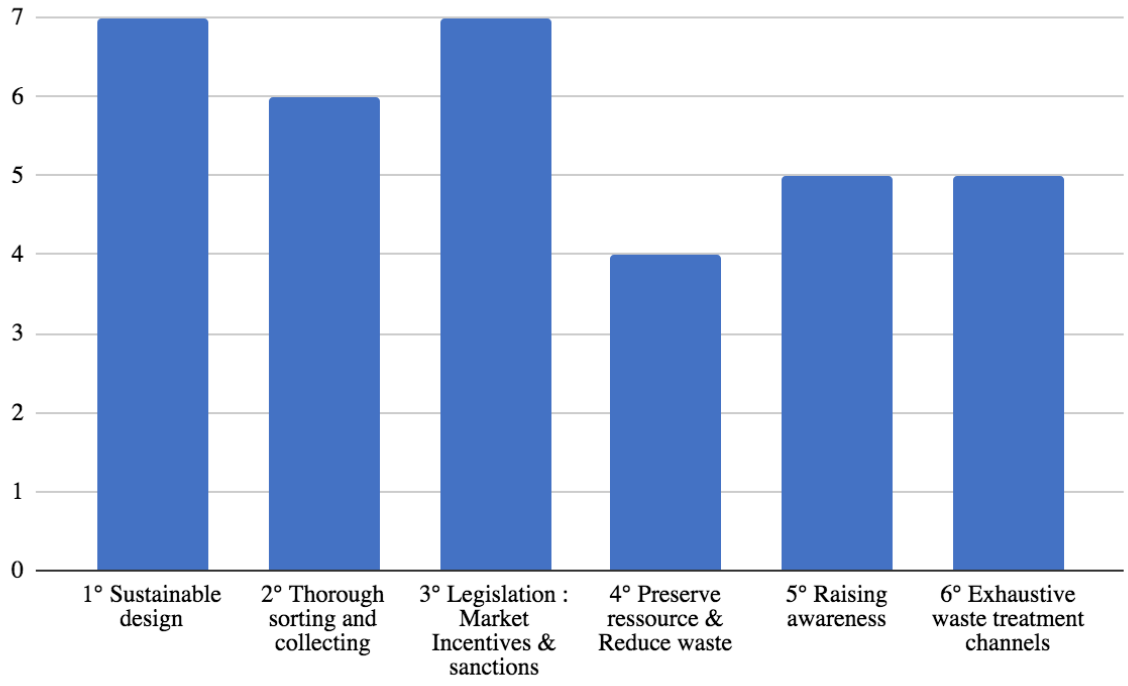


Chart 1: *Q°1 Results column chart*

Sustainable design: Every participant pointed to Sustainable design as a crucial criterion when implementing a CWMS. Also known as Eco-design, it is defined as the process of integrating the environmental concerns of a product when designing it. Through such method, one aims to reduce as much as possible the negative impact on the environment, taking into consideration the product's whole life cycle from the choice of its basic materials, to its assembling and how it will finally be disposed so that it can be valorized as efficiently as possible (Bhamra, 2004). If such practices were applied, residual waste would drastically reduce as more products could be reused or recycled.

"Product and packaging design should be thought in a way that when thrown it's not turn into hazardous material or residual waste."

Janek Vähk - Minute 9:04

"When you start having waste that is an assembly of mixed materials, such as paper, plastics, and different colors of ink, we have a problem upstream, of product design... We must realize that the packaging that we integrate in our economy has to be manufactured in a way that it can be reused or recycled properly afterwards: For human and for environmental health purposes."

Maxime Pernal - Minute 12:20 (translated from French to English)

Legislation: Market Incentives & Sanctions were also addressed by all participants as necessary. If regulations and incentives are not implemented in a way that priorities a long-term dynamic of resource management, the coordination between the community, the state and the manufacturers will never be reached. As mentioned in chapter II, legislations such as the tax on plastic emission can certainly discourage companies from spreading such materials in the market. Those changes should be coordinated with incentives pushing towards salvaging materials instead of turning to sorting centers that are forced to choose weak environmentally responsible treatment solutions because of their convenience and lower costs.

"It is necessary to make a life cycle analysis of products that we manufacture so that they can be taxed on their recyclability. That's what it's missing nowadays: the coordination and organization of stakeholders and the legislation that comes with it."

Gérald Valay - Minute 58 (Translated from French to English)

"Waste sorting centers are subjected to the dynamics of the market, some materials lose their value whilst others gain. Technically, almost everything can be recycled, but you have to consider the economic relevance of recycling such a waste stream. Market incentives are not present in a way that we put more value in recycling, so we end up treating recyclable waste as residual waste."

Gérald Valay - Minute 18:30 (Translated from French to English)

Thorough sorting and collection of waste in our communities was brought up by six of the seven interviewees. Most of the time, this criterion went hand in hand with **exhaustive treatment channel** of waste which was mentioned by 5 participants. Both of these answers put the focus in making waste streams coming from households more homogeneous and well sorted. Once an object or a material has become waste, the best and easiest way for it to be valorized is by separating them as extensively as possible. Yet, the more waste is sorted, the more numerous these waste streams will arrive to the sorting facilities. This implies developing specific infrastructure to recycle each of them downstream, otherwise they would be considered as residual and ultimately be incinerated, put in landfills or sent to other countries to be treated. Pairing separated waste collection with enough treatment channels to greet them are the first steps towards a more efficient waste system, especially in crowded urban areas such as Brussels. Even though BCR does not possess robust treatment infrastructures, it implements a scrupulous sorting of MSW in a way that organizes clean waste streams and sends them to the right treatment channels.

"We have a problem of recycling infrastructure in Europe overall. The infrastructure is not present."

Maxime Pernal - Minute 12:40 (Translated from French to English)

As for **raising awareness** and **preserving resources & reducing waste**, they were respectively used by five and four out of the seven participants. Both of these answers are similar in their approach as they predominantly take citizens and consumers accountable for participating in a circular management system. Even though preserving resources accounts for the action of governments and manufacturers, they are a crucial stakeholder in municipal ISWM. Without having conscious and knowledgeable citizens, the loop could not be closed.

"We can incinerate it, we can put it in landfields, we can recycle it, but nevertheless we should improve the way we sort our waste at home and reduce as much possible our overall waste consumption. The best waste is the one that we don't produce."

Sofia Figueiredo - Minute 26:30

"*Good awareness is required so that people sort waste correctly, especially through motivation and education. We need to establish a responsible sorting and consumption culture."*

Georges Dumbruch - Minute 5:30

2. *When it comes to a circular Municipal Solid Waste management system, do you believe Waste to Energy incineration is inevitable?*

As seen in chapter II, residual waste consists of material left after any waste treatment process. An ISWM involves the coordination of waste production, recycling, energy recovery as well as having different options for disposal (Environment Thesaurus EEA, 2016). In this scenario, the question of residual waste stands as a crucial problematic. Europe's priorities are currently focusing on limiting land filling and focusing instead in upstream solution to reduce residual waste as much as possible.

Nevertheless, according to the Confederation of European Waste to Energy Plants, "There are many everyday waste items made of mixed or dirty materials which will be very difficult to recycle (e.g. sponges, gift and candy wrappings, toothbrushes, old shoes etc) even after the implementation of a full circular economy. In addition, there are recycling residues and materials that will still be degraded due to repeated recycling or ageing. Others will be polluted with substances of high concern, for example heavy metals or flame retardant" (CEWEP, 2015). Thus, some actors believe that there will always be residual waste and as such, Waste to Energy incineration presents itself as a potential solution to provide the highest valorization possible of such materials. On the other hand, associations such as Zero Waste Europe take a stance against waste incineration as a long-term solution, warning that treatment practices releasing carbon emissions in the atmosphere should be obsolete in a CWMS.

2° When it comes to a circular Municipal Solid Waste management system, do you believe Waste to Energy incineration is inevitable?		
Answer Type	Participants	**Total**
1° Yes, strongly agree	*Maxime* *Georges*	**2**
2° Yes, moderately agree	*Gérald* *Sofia* *Wouter*	**3**
3° No, don't agree	*Janek*	**1**

Table 3: *Q°2 When it comes to a circular Municipal Solid Waste management system, do you believe Waste to Energy incineration is inevitable? (RESULTS)*

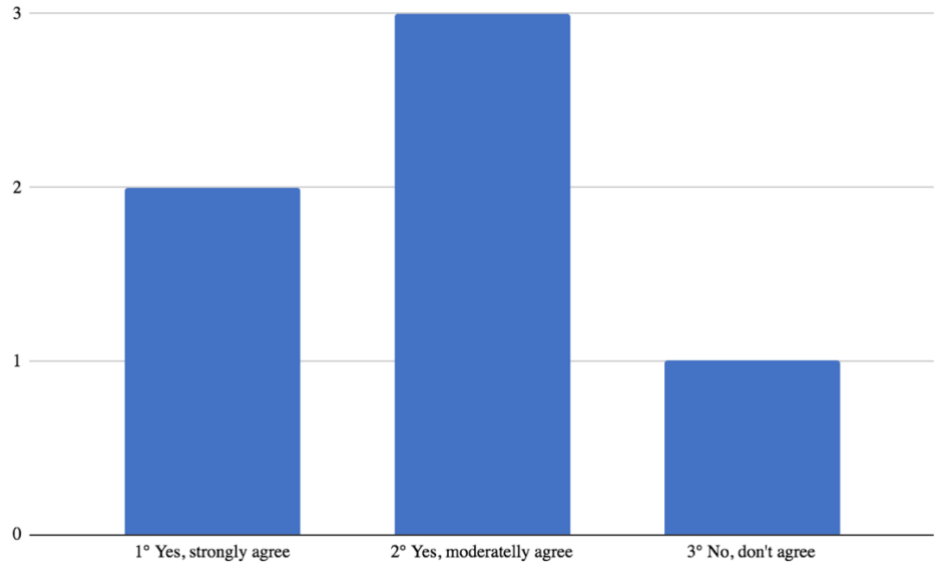


Chart 2: *Q°2 Results column chart*

Overall, participants seem to **agree** that there will always be a necessity for WtE incineration for residual waste to some extent. Most of the interviewees, three of the six that answered, replied that they **moderately agreed** with the question. Not surprisingly, participants related to the WtE incineration industry **strongly agreed** with such statement. The main argument not only being the usage of such technologies for getting rid of residual waste but also as a way to avoid the introduction of impurities in the production cycle. As certain materials such as plastics can only be recycled a limited number of times, those participants warned that if they were to be recycled anyways, they could blend with cleaner materials and not only damage the quality of the recycled materials but also pose a danger for human health:

"Incineration with energy recovery is necessary in a circular economy because there is always some residual waste that we cannot or we do not want to recycle."

Georges Dumbruch – Minute 12:05 (Translated from French to English)

"We have to capture the unwanted elements and make sure they are processed properly. If we recycle them, we diffuse them throughout the all production cycle and we end up having an unhealthy system. Of course there is an impact in terms of CO2, there is a combustion so it is unavoidable, but in terms of hazardous substances, recent studies show that the smokes coming out have no impact on human health."

Maxime Pernal – Minute 23:45 (Translated from French to English)

Nevertheless, most of participants **moderately agreed** with this statement and they supported that there is a necessity for such tools at the moment but that this technique comes with economic and environmental costs. They share the idea that ultimately WtE incineration should not be looked at as an end, but as a current necessity that should be used as a last resort.

"In the reality in which we find ourselves, it is rather the case. This should not be an argument to continue to manufacture this kind of waste, residual materials should not be introduced in the production cycle in the first place."

Wouter Achten – Minute 49 (Translated from French to English)

"You will always need incineration for the waste you can't recycle. But you should always put the priority on recycling as much possible so that you recuperate as much materials as possible and finally, if necessary, incinerate."

Sofia Figueiredo – Minute 48:45

Finally, one of the six participants **disagreed** that incineration is inevitable for a circular treatment of our waste. It is important to mention that the participant is part of Zero Waste Europe organization which openly opposes to waste incineration. Nevertheless, even if the interviewee ultimately disagreed with such statement, he did mention that current societies did not possess a more efficient solution to get rid of residual waste. Carbon emissions being at the center of climate change, such a standpoint mainly goes against encouraging solutions that contribute to increasing CO2 levels. The answer mainly highlighted the fact that the effort had to be made upstream, at the conception of products in a way to decrease residual waste at a maximum.

"If we are talking about circular waste management when you minimize waste and residual material waste, you could have a future where we don't need incineration."

Janek Vähk - Minute 21:40

"When you have an incinerator you need waste to make it work so you keep feeding it which is not a great incentive to find other solutions and work towards a more circular economy."

Janek Vähk - Minute 23

3. ***According to you, can WtE incineration technology be considered as a renewable source of energy?***

In the Directive EU 2018/2001 on the promotion of the use of energy from renewable sources, Article 2, Section 1, the definition of renewable energy is presented as following: 'energy from renewable sources' or 'renewable energy' means "energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas" (Directive EU 2018/2001 on the promotion of the use of energy from renewable sources, 2018). This description foments debate within the waste management community. On one side, supporters of WtE incineration often consider such technologies as renewable sources of energy as long as the incinerated waste is from biogenic origins, wood or coal for example. The main argument is that carbon released by the combustion would inevitably have happened at the end of their life cycle, as biogenic materials are carbon-based organisms. Thus, such methods do not add more carbon to the atmosphere and do not contaminate as much as disposing them in landfills. If biogenic waste is brought to landfills, it results in an anaerobic breakdown which then produces methane. Methane is often presented as more pollutant than CO2. But through such tools there is at least an energy recovery from this inevitable CO2 release.

3° According to you, can WtE incineration technology be considered as a renewable source of energy?		
Answer Type	Participants	**Total**
1° Yes, strongly agree	*Maxime*	**1**
2° Yes, moderately agree	*Georges*	**1**
3° No, don't agree	*Janek* *Sofia*	**2**

Table 4: *Q°3 According to you, can WtE incineration technology be considered as a renewable source of energy? (RESULTS)*

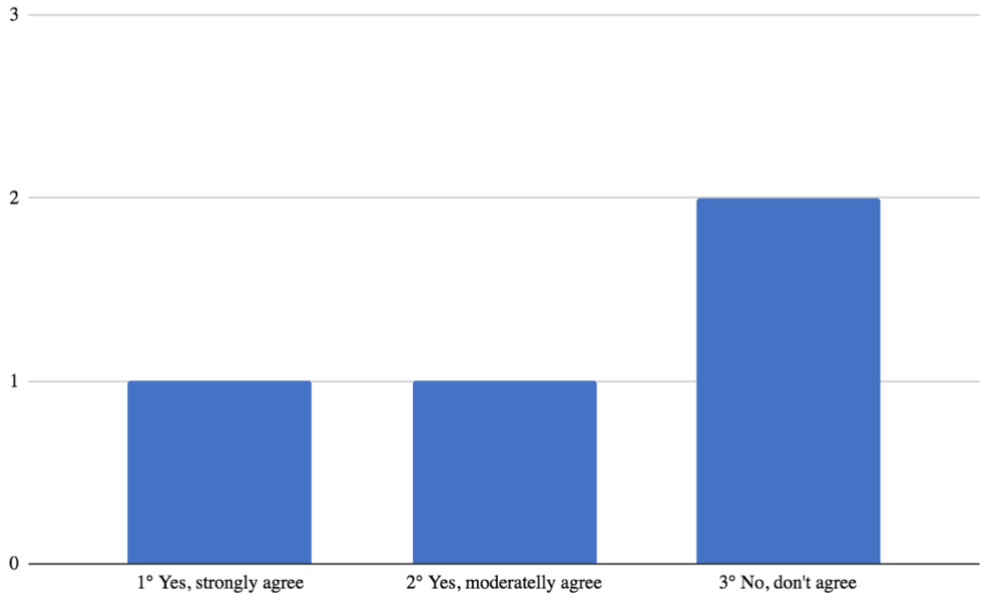


Chart 3: *Q°3 Results column chart*

Two out of four participants having answered this question **agreed** with such a statement, even though they did not share the same exact opinion. One **strongly agreed** while the other **moderately agreed**.

> *"It is already considered a renewable source of energy in a way… It depends on the definition we use. At the European legal level, renewable energy can come from biomass, including some that are present in MSW, those who have biogenic origin at least, like coal, cotton, leather, paper... The carbon emissions that will be released by the combustion of waste is a carbon that was already stored in nature and will inevitably produce carbon at the end of its life cycle. The European legislation defines it this way. It doesn't add any more CO2 than it's natural cycle. As for materials based in fossil sources, such as plastic, it is not the same..."*
>
> Maxime Pernal - Minute 27:15 (Translated from French to English)

Nevertheless, other stakeholders related to the waste treatment industry are concerned with this definition, stating that this explanation does not encourage the reduction of GHG emissions to a minimum. The idea of producing energy through the exploitation of biogenic limited resources is not foreseen as sustainable in the long term, renewable energy being nowadays paired with the dimension of infinite, and not limited, sources of energy. So, they propose other treatment solutions that do not depend on combustion to handle those waste streams such as controlled anaerobic digestion of biomass.

"It's not sustainable to keep burning our resources. Incineration can not be considered as renewable."

Janek Vähk- Minute 28:45

"If we still invest in Incineration, we are still investing in air polluting technologies."

Sofia Figueiredo - Minute 55

4. *Do you believe that there is an influence of the development of Incineration technologies on the expansion of Recycling Technologies?*

As the environmental impact of WtE incineration and their role in a CWMS were examined through the question two and three, participants were asked if they thought that such practices could slow down the development of recycling technologies.

4° Do you believe that there is an influence of the development of Incineration technologies on the expansion of Recycling Technologies?		
Answer Type	Participant	**Total**
1° Yes, there is an influence	*Sofia* *Janek* *Gerald*	**3**
2° No, they go hand in hand	*Georges* *Maxime*	**2**

Table 5: *Q°4 Do you believe that there is an influence of the development of Incineration technologies on the expansion of Recycling Technologies? (RESULTS)*

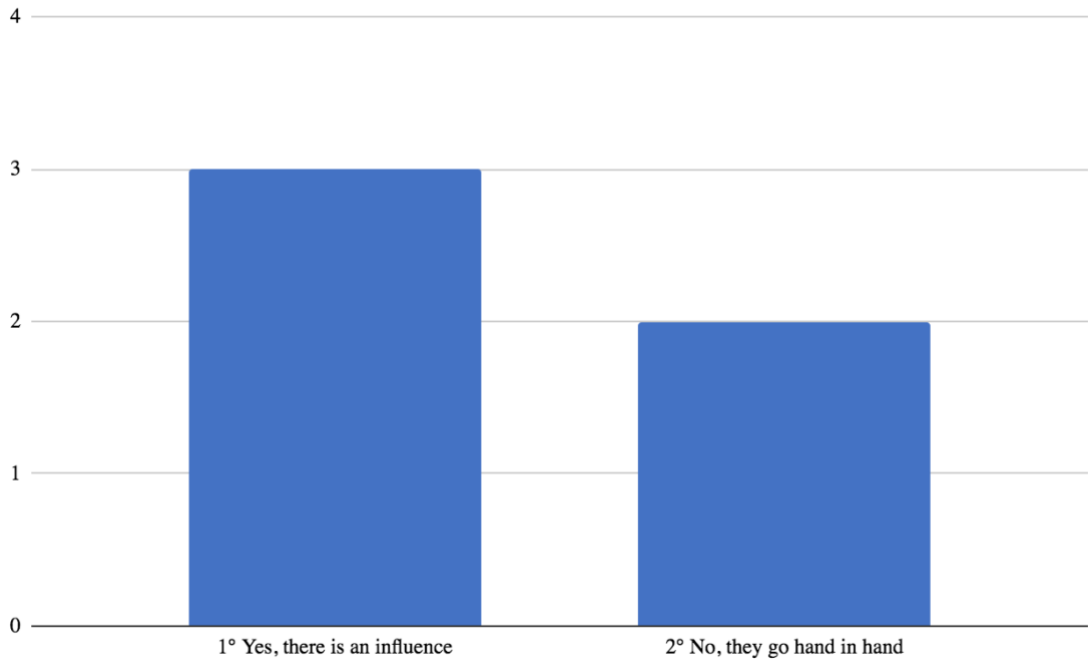


Chart 4: *Q°4 Results column chart*

Out of a total of five participants who replied to this question, three **agreed that there was an influence**. They claim that even though recycling is increasing due to regulatory pressure, the development of waste incineration technologies is, and could exponentially, influence the recovery of certain materials classified as hazardous waste even if they perfectly recyclable.

> *"If you don't bring in the necessary amount of waste to your incinerator, you're not profitable and your energy production is not efficient. Therefore, it is not in the interest of incineration plants to develop sorting and, ultimately, waste recycling channels."*
>
> Gérald Valay - Minute 21:50 (Translated from French to English)

> *"There are statistics showing that when they open an incinerator, waste recycled reduces. We can't forget that an incineration plant actually ends up burning recyclable waste. There is a correlation, incineration plants end up undermining recycling technologies."*
>
> Janek Vähk - Minute 42

On the other side, two out of five participants argued that WtE incineration **go hand in hand with recycling technologies**, and therefore there is no negative influence. They often look at such technologies as having a key role in the future of the circular economy. The main argument presented is that European countries who having the highest rates of recyclability are often those who develop a well-coordinated relation between recycling treatment channels and incineration with energy recovery solutions. Furthermore, they also stated that incineration of some specific materials can ultimately be less polluting in some situations. By wanting to recycle at all costs there could actually be a more harmful impact on the environment.

> *"The countries that recycle the most in Europe are countries that rely on incineration. The European countries that have managed to reach the 50% mark of MSW recycling all rely on incineration plants. As soon as we reach 60% it is very hard to do without incineration."*
>
> Maxime Pernal - Minute 55:20 (Translated from French to English)

> *"You also have to ask yourself the question: How much energy it takes to recycle a specific type of waste (water, electricity, solvent...)? If the environmental cost for recycling is higher than not doing so, the question must be asked. The same question applies to a financial and political level. How much does it cost or should we even recycle if it is not the cheapest solution?"*
>
> Maxime Pernal – Minute 13:45 (Translated from French to English)

5. ***Taking into consideration the Lensink Ladder, otherwise known as the "waste hierarchy", in which steps do you believe there are the most commercial opportunities?***

As seen in chapter II, the waste hierarchy set up by the European Union has 5 different steps: (i) Prevention, (ii) Reuse, (iii) Recycling, (iv) Recover and (v) Disposal. When asked this question, participants often selected multiple answers indicating that none of these steps are yet completely achieved in addition to opportunities being available in each one of them. Nevertheless, they were asked to provide their opinion on the sector where there would be the most interesting commercial opportunities. The answers will now be presented by order of importance.

5° Taking into consideration the Lensink Ladder, otherwise known as the "waste hierarchy", in which steps do you believe there are the most business opportunities?		
Answer Type	Participant	**Total**
1° Prevention	*Alain, Georges, Janek, Maxime*	**4**
2° Reuse	*Janek, Georges*	**2**
3° Recycling	*Sofia, Alain, Gerald, Georges, Janek, Maxime, Wouter*	**7**
4° Recovery	*Gerald, Maxime*	**2**
5° Disposal		**0**

Table 6: *Q°5 Taking into consideration the Lensink Ladder, otherwise known as the "waste hierarchy", in which steps do you believe there are the most business opportunities? (RESULTS)*

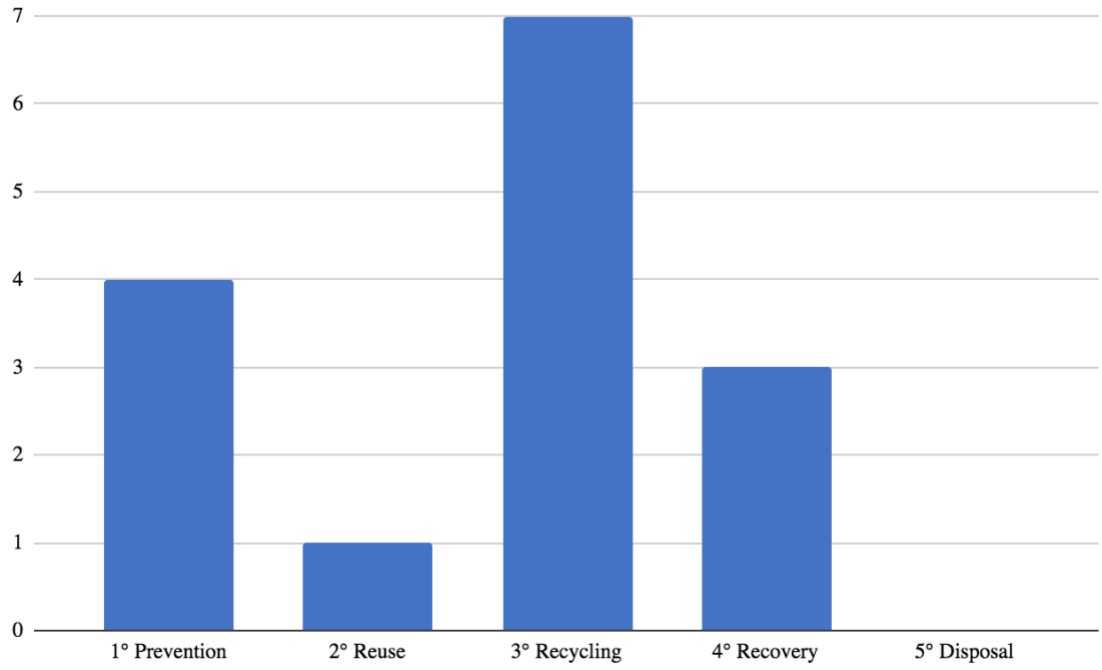


Chart 5: *Q°5 Results column chart*

Recycling was unanimously advanced by the seven participants. Even if these experts work in different areas of the industry and, as seen previously, have different opinions when it came to their perception of the main features of an ISWM system, recycling was presented as the most important step of the waste hierarchy by each one of them. More specifically, they point to the development of exclusive recycling treatment plants to tackle the variety of waste streams present in the economy. These participants range from the all over the waste hierarchy spectrum, ranging from waste prevention (Janek Vahk and Maxime Pernal) all the way to waste disposal (Gerald Valay), but also recycling (Alain Maubert) and energy recovery (Georges Dumbruch) actors. Nevertheless, they unanimously shared the same point of view when it came to this question. No matter in which part of the industry the participants worked, recycling was presented at the top of the hierarchy were there are more business opportunities.

"Europe has had an irresponsible behavior ever since the 1990's and is now without the industrial infrastructure to correctly recycle its waste and, now, without an outlet abroad to go to (speaking about China Ban). It is in this sense that there will be commercial opportunities in Europe in the years to come. Most European countries have sorting centers. But what is missing behind are the recycling centers, the infrastructure to process this sorted material. There are not enough waste processing solutions."

Gérald Valay - Minute 30:30 (Translated from French to English)

Prevention was selected by four of the seven participants. This notion was not only presented by the idea that there is a need for reduction of our waste consumption overall but also the need for a more thorough coordination between manufacturers and the processing solutions downstream. Products should be designed in a way that facilitate their reintegration in the production cycle in the easiest and most efficient way possible.

"The first thing is prevention, the ideal is not to produce any waste. The best waste is the one that is not produced."

Maxime Pernal - Minute 36 (Translated from French to English)

"Many products that are supposed to be recyclable can actually only be re-introduced in 20/30% of new products. What do we do with the other 70%? The main problem is that today we let products enter the market for which we didn't verified that 100% of it could actually be recycled."

Alain Maubert - Minute 38 (Translated from French to English)

Recovery and **Reuse** were both mentioned by two of the seven participants. Depending on the definition, recovery could be understood in two different ways. From one side it could take into account energy recovery from high quality materials, more specifically biowaste which is often considered as an actual sustainable source of energy (Pavlas & al., 2020). Whilst on the other, it could only refer to energy recovery from residual waste which involves incineration and thus not the same. Unfortunately, there is no clear definition presented in the Waste Directive Framework of 2008 that indicates where Biowaste treatment techniques are set

in the hierarchy. For the sake of the research, only incineration of residual waste was taken into account for this section.

> *"There will be a need for residual waste treatment facilities if we are to meet the goals set by the European Union."*
>
> Maxime Pernal - Minute 47 (Translated from French to English)

As for **reuse,** the objective is to prevent an object from being discarded in the first place. Instead, there should be research in the ways to be reintroduced directly in the economy before considering it as a waste.

> *"We should look more closely into reusing products before actually considering them as waste, because recycling is not enough and it isn't a perfect solution. For example we could have a common database for sharing knowledge on how to repair devices."*
>
> Georges Dumbruch - Minute 65 (Translated from French to English)

Finally, **disposal** was not surprisingly rejected by all participants as the European Union has clearly set its priorities and targets regarding landfill disposal. There are then no commercial opportunities perceived by the participant in this sector.

6. ***In your opinion, what do you think might be the main technological, logistical and business related opportunities when it comes to improving waste management systems towards more circular schemes? (e.g. the development of specific material treatment plants, household waste sorting, different waste collection systems…) And more specifically for the Brussels Capital Region?***

Ultimately, implementing a circular economy would have positive environmental and social impacts. But recent research found that it could also have a strong positive impact on the economy, potentially generating €1.8 trillion of profit for the European Union by 2030 (Europe's circular-economy opportunity, McKinsey CB&E, 2015). Furthermore, a recent study analyzed the potential benefits when it came to implementing circular economy measures for waste prevention, material recovery, logistical practices and sustainable design of products. It estimated a profit of 245 billion to 604 billion euros (Circular economy in Europe, EEA Report

No 2/2016, 2016). In such an upcoming profitable market, business opportunities will open up not only in BCR but all across Europe.

6° In your opinion, what do you think might be the main technological, logistical and business related opportunities when it comes to improving waste management systems towards more circular schemes? (e.g. the development of specific material treatment plants, household waste sorting, different waste collection systems…) And more specifically for the Brussels Capital Region?		
Answer Type	Participant	**Total**
1° Organic Waste treatment	*Sofia, Gérald, Georges, Janek, Wouter*	**5**
2° Plastic treatment	*Alain, Gérald, Georges, Maxime*	**4**
3° Waste collecting solutions	*Gérald, Maxime, Wouter*	**3**
4° Sorting technologies and facilities	*Alain, Gérald, Maxime, Wouter*	**4**
5° E-waste treatment	*Alain, Gérald, Georges, Maxime, Wouter*	**5**
6° Sustainable design	*Alain, Gérald, Georges, Janek, Maxime, Wouter*	**6**
7° Deposit Return Scheme Development	*Alain, Janek, Maxime*	**3**
8° Raise awareness	*Georges, Janek, Maxime*	**3**
9° Reuse/Repair initiatives	*Janek*	**1**

Table 7: *Q°6 In your opinion, what do you think might be the main technological, logistical and business related opportunities when it comes to improving waste management systems towards more circular schemes? (e.g. the development of specific material treatment plants, household waste sorting, different waste collection systems…) And more specifically for the Brussels Capital Region? (RESULTS)*

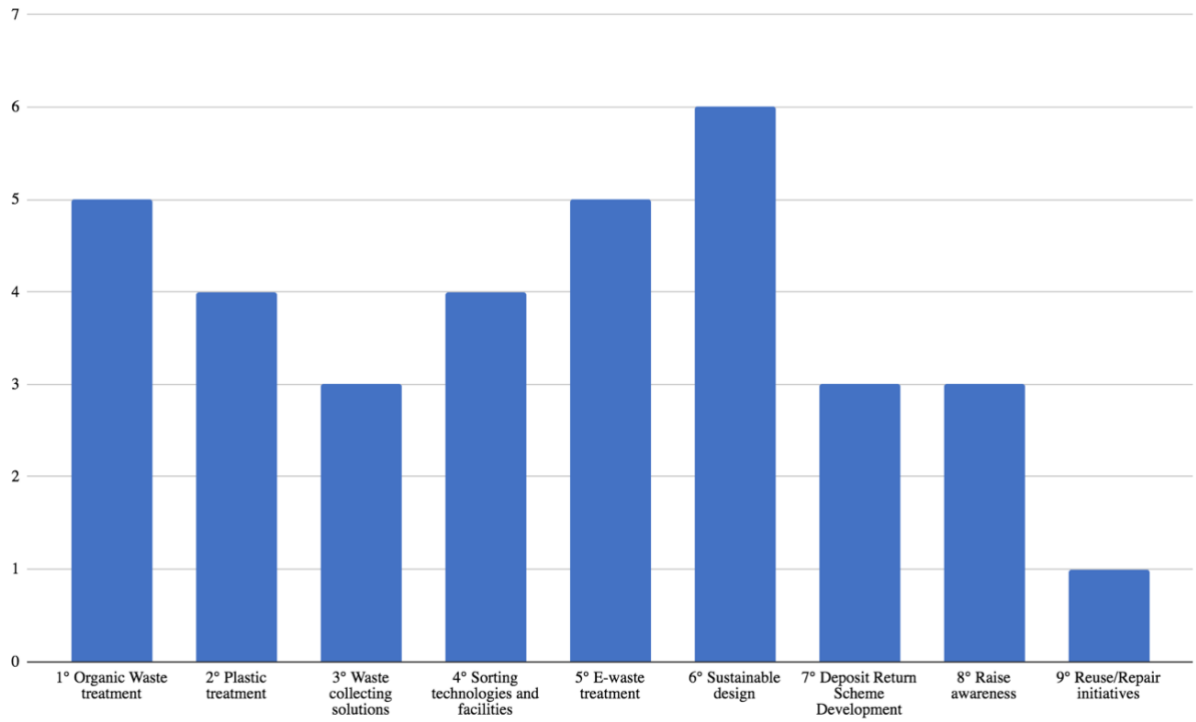


Chart 6: *Q°6 Results column chart*

Sustainable design was chosen by six out of the seven the participants. Unsurprisingly, sustainable design, also known as Eco-design, is at the top of priorities when it comes to the waste hierarch as prevention is the first step. The demand for environmentally conscious products will increase as it tackles the problem of MSW at its origin. The way we manufacture products should be aligned to the recycling solutions downstream. Through such method, one takes into consideration the product's whole life cycle from the selection of its base materials, to its assembly and its disposal, so that it can be valorized as efficiently as possible (Bhamra, 2004). The importance of switching the stance from a linear perception of product design to the circularity paradigm will play a key role in the upcoming years. Residual waste would also drastically reduce as more products are reused or recycled.

"*We must stop seeing the waste as a final step but rather go up the chain and rethink how we design our products.*"

Georges Dumbruch - Minute 66:40 (Translated from French to English)

Five out of the seven participants mentioned **Organic Waste treatment** as one of the main business opportunities. Bio-waste is the largest component of MSW in Europe households with an average share of 34 %. Collection and recycling solutions for this waste stream will be highly demanded as the EU countries are set to recycle 65 % of their municipal waste by 2035. Between 2014-2020, the financial instrument of the European Union for sustainable entrepreneurship "Horizon" allocated around €3.7 billion in Bio-waste initiatives (Towards a circular economy – Waste management in the EU, 2017). Through organic waste, we can produce both energy, such as biogas that can be used for heating local households or commercial areas, or even as an alternative fuel for public transportation. The solid volume remaining after the anaerobic digestion does not become a load, contrary to other types of WtE solutions. It could be used as fertilizer, or soil nutriment, compost that could be fed to neighboring agricultural fields. Collection and valorization of biowaste in a separate fashion solves significant problems. It avoids GHG emissions, such as methane, when brought to landfills and it also improves the efficiency of WtE incinerators as biogenic waste reduces the temperatures of the furnaces since organic waste is mainly structured of H20 molecules.

The city of BCR has already started the collection of organic waste in households. This waste stream is brought to bio methanizations centers outside of the region. But projects of opening a treatment center in the region is still being debated.

"Organic waste treatment facilities are the biggest opportunities in Europe at the moment, organic waste is one of household waste that can be the most valorized. As a lot of household waste is organic, there is a lot to do around this type of waste."

Sofia Figueiredo - Minute 60:03

"Opening a bio methanization center is a real opportunity for the city of Brussels. We lose all the nutrients by incinerating our organic waste. With bio methanization we recover much more energy than incineration."

Janek Vähk - Minute 34:30

E-waste treatment was mentioned by five participants as well. European Parliament research showcased potential revenues from e-waste recycling at €2 billion in Europe. WEEE being one of the fastest growing waste streams in the EU and the world, estimated at 3% to 5% per year. (Towards a circular economy – Waste management in the EU, 2017). The valuable components present in such waste stream could still be reused and put back into the economy. Thus, if applied extensively, the necessity for extracting raw materials from mines could decrease, which has a non-negligible positive impact for the environment. The potential of 'e-waste' is substantial. The materials present inside WEEE are considered to be Critical Raw Materials as the metals and minerals are often imported from outside the continent and also, highly reusable. Dense urban zones, such as BCR, have become actual mines for old electrical appliances containing enormous wealth (Recupel Annual Report 2018, 2018). Brussels WEEE collecting and urban mining company Recupel has generated a profit 254€ million in 2014.

"There is a lot of work to do with all the electronic waste. They don't take a lot of space and it don't seem to be a high-derived hazardous waste."

Alain Maubert - Minute 25 (Translated from French to English)

"There is probably a high profitability in electronic waste treatment. The concentration of metals is higher in a ton of electronic waste than in a ton actually coming from a natural mine."

Wouter Achten - Minute 20:20 (Translated from French to English)

Plastic treatment was cited by four out of the seven participants. As seen previously, European legislation is driving an increase in the demand for recycled plastics. Regulations and customer awareness have resulted in an important increase in the volume of plastic waste collected for recycling in Europe. But earlier waste behavior from European countries in addition to China's recent tightening regulations regarding the importation of solid waste from foreign countries led to an important gap in the plastic recycling sector. The infrastructure is not yet diverse and present enough to tackle this fragmented market (The plastic recycling opportunity KPMG, 2019). The target set by the Circular Economy Package expects 65% of plastic packaging waste coming from household to be recycled by 2035. Thus, as the tax of 0.8€ per kilogram (800€ per tones) has been set for non-recyclable plastic emission, recyclable plastics are set to be more in demand than ever before. The potential benefits for recycled plastics could reach up to 1872.4 million €, depending on the quality prices of the plastic material (Deloitte Sustainability, 2017).

"There is considerable opportunity to develop specific channels for processing and using plastics. More specific recycling channels for plastics."

Georges Dumbruch - Minute 15:45 (Translated from French to English)

Four of the seven interviewees mentioned **Sorting technologies and facilities** as potential business opportunities for MSW. Even if automated sorting technologies for mixed municipal waste already exist, they are not as precise and efficient as human separation. There will be an increasing need for optical, automized, and sorting solutions as the industry will be expected to treat larger quantities of waste, quicker and more accurately than ever before. Municipal waste is one of the most complex and polluting waste streams, but it has a high potential for valorization if sorted in the right way.

"Automated optical sorting systems are very much in demand. We are hoping that they will be able to sort more accurately waste, specially when they require more specific sorting, such as plastic."

Alain Maubert - Minute 16 (Translated from French to English)

Highly dense urban capitals such as Brussels are limited by their space which in turn directly impedes the construction of new recycling facilities. Nevertheless, as mentioned by

circular economy researcher Wouter Achten, the efforts of such areas are going to be more oriented towards **preparing** waste streams to be valorized or recycled. Cities as dense as BCR will rely on a complex and diverse network of entities collecting and preparing specific waste streams to be treated.

> *"The role of a city like Brussels is rather the preparation for circularity at a higher level, more globally. There is more than trying to be absolutely circular inside of BCR itself. We prepare, for example, the recovery and collect of metal after incineration waste, but we don't try to treat the metals within Brussels."*
>
> Wouter Achten - Minute 27:40 (Translated from French to English)

Deposit Return Scheme Development (DRS) was mentioned by three of the seven participants. DRS is a system where consumers pay a deposit for the packaging of a certain product which will then be reimbursed when the container, or product, is returned to the collection point. The DRS offers an economic incentive to the consumers to return the empty packaging instead of disposing of it each time it has served its purpose. Moreover, this system allows the consumer to refill or reuse the product numerous times, putting an end to single use package which ultimately reduces waste (DRS Zero Waste Europe, 2015). Given that European countries aim to develop a system that reduces the use of virgin materials and manages efficiently waste streams, Zero Waste initiatives are becoming more common in BCR as found in supermarkets, bike repair workshops, food suppliers, cosmetic stores and garment shop. Such initiatives are sprouting in Brussels and other urban, dense, areas not only because consumers are more aware of their consumption and their waste emissions, but also because there are stricter national and European legislations regarding the Extended Producers Responsibility for packaging waste (Development of guidance on EPR, 2014).

> *"Initiatives of consumption homologated to zero waste present great potential."*
>
> Maxime Pernal - Minute 68:30 (Translated from French to English)

> *"Create bulk stock outlets for refillable products. All the investment could be dedicated in the product and its quality, not in the packaging."*
>
> Alain Maubert - Minute 42:50 (Translated from French to English)

Three participants stated that there will be commercial opportunities in initiatives that **raise awareness** in waste practices for citizens. The EU started the Cohesion Policy which promotes waste prevention and reuse, amongst other waste management initiatives, by financing such projects at a local level (Closing the loop – EU Action Plan, 2015). A 5.5€ billion fund for waste prevention was implemented and with Prevention at the top of the Waste Hierarchy, these projects have increasingly been appearing in Europe (Cohesion policy support for the circular economy, 2015). Bruxelles Propreté is the regional agency that is in charge of raising awareness in BCR and they work closely with citizens and entrepreneurs to promote responsible behavior.

> *"Not only there is a lot of passage of people that live here, which are not aware of our sorting practices, but also there are many people who are not really educated to sort their waste correctly. It's often due to the socio-cultural disparities, inequalities, present in the region. Hundreds of nationalities living together, it is difficult to coordinate and communicate the right information. We could recycle, recover more material, have cleaner streams, if people were more aware of what they put in the bags."*
>
> Maxime Pernal - Min 66:25 (Translated from French to English)

> *"When we did sorting and waste consumption warning campaigns in Brussels, you could actually see the result in separated waste collection rate error for household waste. The rate of error dropped dramatically, around to 12%. Now most of the time it's more like 25-30%."*
>
> Georges Dumbruch - Minute 15 (Translated from French to English)

Waste collection solutions was mentioned by three interviewees as well. EU regulations are requiring thorough separated collection of waste as it improves the potential for a better and more qualitative recycling. Given the mixed material nature of municipal waste, separation and collection of those materials are crucial. The European Environment Agency stated that municipal waste could potentially reach 80% of sorted collection rate (based on waste statistics from the year 2018), mainly coming from bio and plastic waste (Potential for increasing recycling in Europe, 2020). Even tough waste collection is mainly managed by local

municipalities, private or citizen collection initiatives focusing in specific waste streams will play a role in the future.

> *"We have to make waste collection as simple as possible for people, it's not a priority for everyone and we can't force them to be interested in such an activity."*
>
> Maxime Pernal - Minute 67 (Translated from French to English)

Reuse/Repair initiatives was only mentioned by one participant even though it has a predominant role in the Waste Framework Directive, above recycling and valorization practices. It is said that a correct implementation of reuse or repair systems could save up to 1/3 of items arriving at recycling centers and collection points from premature recycling, landfilling and incineration (Rreuse, 2017). Furthermore, such programs provide job opportunities for people that are often detached from traditional labor markets, which is one of the pillars of a circular economy. Les Petits Riens is a very successful Brussels based non-profit organization that collects around 8 000 tons of second-hand items per year (clothes, furniture, household appliances) and employs around 300 people nationally, offering work to homeless and previously incarcerated people. In 2019, Les Petits Riens reached a total revenue of 12,4€ million by selling recuperated items that were initially considered useless (Les Petits Riens Annual Report 2019, 2019).

VI. Conclusion

A. Key Takeaways

When it came to defining the main characteristics of a CWMS, six features were determined (presented by order of importance): the execution of **sustainable design** in the production process, the implementation of **legislation** that structures and coordinates such configuration, **thorough sorting and collection** tools for household waste, as well as **exhaustive treatment channels** to accept these different waste streams, have **conscient, knowledgeable**, consumers and citizens and, finally, **preserve** our resources and **reduce** our waste production overall.

As for the treatment of **residual waste**, the main results demonstrated that WtE incineration was currently the best treatment method available and will probably be the best solution available for treating such waste stream in a CWMS. Nevertheless, if the definition given by Waste Framework directive of 2008 can partially qualify such treatment method as a renewable

source energy (if waste stream incinerated has a biogenic origin), experts do not seem to agree that the extraction of energy through the incineration of limited resources is sustainable in the long term. Furthermore, participants expressed some cautionary notes regarding the usage of such treatment methods in a circular waste management scheme. More particularly, the influence that these technologies could have over the recovery of certain materials being classified as residual waste even though they are recyclable can ultimately undermine the development of waste recycling.

Finally, when transitioning from a linear to a CWMS, and more specifically in BCR, the commercial opportunities were mainly located at the **Recycling** and **Prevention** stages of the waste hierarchy. More specifically, **sustainable design** was presented as the most important business prospect, followed by different but specific waste streams that will need to be recycled in the future. Starting by **organic waste**, then **E-waste** and finally **plastic** polymers. The amount of these three different waste streams is set to be constantly increasing in the upcoming years and European regulations on Waste are dictating targets that will stimulate the market, and ultimately present opportunities for entrepreneurs. Moreover, **sorting technologies and facilities**, waste **collecting solutions**, **DRS initiatives**, initiatives that contribute to **raising collective awareness** on MSW and **reuse & repair** initiatives were all stated to having potential for entrepreneurial ventures.

B. Limitations

In this section, the limitations of the research will be elaborated. Firstly, the best management solution is different for every country, region, city or community. There are too many factors to be taken into account to mirror the same commercial opportunities as BCR in every other dense and populated European cities. The quantity and type of waste streams, the financial and political support available for such initiatives locally, the cultural awareness of the population for such subject, the existing treatment facilities accessible in the area, even the topography and location have an influence on the correct waste management plan for a specific city. The most appropriate waste management solutions have to be analyzed for each specific case, taking into consideration the legislation and directives stated by the European Commission (Bontoux, 1999).

Furthermore, a bigger and more diverse sample would be required to draw conclusions that are academically legitimate. Participants in this research were all experts in waste management,

from different sectors of the industry. Not all of them were specialists when it came to circular waste management in BCR. It would be interesting to raise the same questions with more participants. As the analysis was conducted through a qualitative research method, based on the content analysis treatment process, the experts' opinions were interpreted and narrowed down in a way to draw conclusions from each question. The problem with such a technique is that it is not flawless and the answers could eventually not be as complexed and thorough as the participant would have wanted to.

Lastly, the interviews were mostly conducted through virtual conference calls given the current situation with the COVID-19 epidemic. Some information could have gotten lost or misinterpreted due to the complex communications involved in conducted interviews remotely. Moreover, some interviews were conducted in French, as not all the participants spoke English. They were then translated, which in turn leads to a marge of error when it comes to accurately interpreting the interviewee's opinion.

C. Future research opportunities

It would be a valuable contribution to have the same questions asked to different experts from other European countries when considering CWMS. The case of BCR could have influenced in different ways the results of this research, more particularly when it came to residual waste treatment solutions. Some European countries are more sceptic to such technologies and make a case that landfilling could be a more suited solution for such waste stream.

Furthermore, future research could also aim to answer which are the different types of commercial opportunity not necessarily oriented towards lucrative businesses but instead towards social businesses. Several circular economy initiatives strive to address social problems which ultimately bring benefits to society. For example, developing e-waste dismantling infrastructures that only recruit former inmates or building a platform which coordinates citizens for organic waste collections in different neighborhoods.

VII. References

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VIII. Appendix

Matrix Table #1: Question 1

Interviewees	1° In your opinion, what are the main characteristics of a circular waste management system?
Sofia Figueiredo	Min 26:30 "bring awareness to people" "We can incinerate, we can put it in a landfield, we can recycle, but nevertheless we should improve the way we sort our waste at home and reduce as much possible our overall waste" Min 27:45:" Cultural awareness" "Making people aware that : we have to reduce our waste at home, by exploring different alternatives in our consumption and sort out as much as possible what we throw in the bean ." Min 30 : "Unless if you get back to the main problem, where the original waste is being produced and thrown, you'll never be able to find a solution" Min 36 "As long as industries don't join their manufacturing habits, this will never change" Min 38 " Having the producers of all these products that are available to us to change their attitudes"
Alain Maubert	Min 35:40 " La responsabilité du recyclage du dechet soit porté par l'entreprise qui est emetteur sur le marché. Il s'agit de l'éco conception. Il faut insister sur la nécessité d'éco concevoir le produit, l'emballage, en intégrant toute la chaine. Min 38" Beaucoup de produit qui dise pouvoir être recyclé enfait ne peuvent réincorporé que 20/30% dans les nouveaux produits... Qu'est ce qu'on fait des 70% restant? Le problème c'est qu'aujourd'hui on laisse entrer dans le marché des produits pour lesquel on a absolument pas vérifier que 100% de l'emballage puisse effectivement être recyclé" Min 40:20 "Ca commence avec l'éco conception, la conception du produit en lui même en évitant des produits qui sont non recyclable en recyclage matière" Min 42:30 "L'émetteur en marché doit être responsabilisé de produire avec des matières qui ne sont pas recyclables. Le prix/la sanction devrait être telle que ces entreprises n'aient plus aucun intérêt à emettre ces produits dans le marché" Min 20:30 Sur les déchets organiques "Reflechir le maillage des instalations industrielles en fonction de l'élongation optimale qu'il y a entre l'endroit ou est situé le déchet et l'endroit ou on a implenté le site de traitement" Min 21:30 "Reflechir aux effets colatéraux des plentes de traitements ou on les implantes" Min 26 "L'emballage plastique des grandes marques est la même à bruxelles, qu'à Buenos Aires et à Ouagadougou. Il faut donc que globalement ces industriels se plient à l'écoconception. Ca veut dire que techniquement on doit pouvoir les recyclés de manière simple"
Gérald Valay	Mn 15:15 "Est ce que c'est raisonnable et intelligent de chercher un produit qui est techniquement favorisable mais finalement il n'y a pas de marché, de demande pour ce matériel final... Pour une gestion circulaire des déchets, il faut conjuguer une stratégie d'élimination des déchets, il faut que le coût pour le citoyen soit raisonnable, il faut que l'on sorte des produits qui soit soummis à une loi du marché des matières secondaires avec des indices de prix qui descendent et qui baissent" Min 18:30 "Les centre de tri sont soumis à des lois de marché, certain matériaux perdent leur valeur et d'autre en prennent, il y a toujours un schéma auquel on doit se confronter. Techniquement, on peut presque tout recycler, mais il faut prendre en considération la pertinence économique de traiter une filière de déchet." Mn 48 "Il faut avoir les système les plus évolutifs possible, il ne faut pas être dogmatique en disant qu'on ne veut pas faire ceci ou cela. Il faut associer un certain de nombre de filière de traitement pour être capable de traiter ces déchets par filière. Il faut à la fois organiser l'ensemble du traitement des dechets en reflechissant à chaque type de traitement par type de déchets" Mn 50 "Il faut dès la conception, dès le début reflechir par fillière. Quelles sont les pourcentages de filière dans les déchets ménagers. Qu'est ce que c'est le plus facile de favoriser. Ensuite tu met ton energie et ton investissement sur les filières de déchets qui sont le plus faciles à traiter pour le prix le plus raisonnable (comme le verre: ca ne sent pas mauvais ca peu se recycler infiniment...)" Min 53 "Il faut être agile parce que les produits d'emballages que l'on fabrique ajd ne sont pas les mêmes que ceux de demain. Il faut donc des équipements qui soit le plus évolutifs possibles" Min 54:30 "Bien connaitre son gisement de déchet afin de dvlp les filières de traitement et determiner ceux qu'on peut en faire par la suite" Mn 56:30 "Le dechet que l'on a pas produit et le dechet que l'on a pas fabriqué" Mn 58 "Il faut faire l'analyse de cycle de vie des produits que l'on fabrique, il faut que la fabrication soit ainsi taxé sur leur recyclabilité"
Georges Dumbruch	Min 2 " À Bruxelles nous avons commencé à trier depuis pas très longtemts et on devrait conscientiser les gens à mieux trier afin de mieux recycler" Min 5:30 "Une bonne conscientisation des gens à trier, surtout de les motiver et les éduquer à trier correctement. Il faut instaurer une culture de triage et de consomation qui soit responsable." Min 7:10 "Ce qu'il faut c'est qu'au niveau de la conception du produit, ou on le crée, le concept de circularité doit être integré". "Qu'il soit facile à recyclé d'une part et qu'il soit réutilisable, ou réparable, l'autre." Min 10:40 " L'exemple le plus flagrant que je connaisse est celui de l'industrie automobile. Il y a 12 ans, on a dit aux constructeurs de voitures qu'en 2020 95% des parties des voitures devront être recyclables, récupérables. Cela a complètement changé l'industrie et a réussi à faire en sorte que les constructeurs automobiles concoivent leur production de cette manière" (Cf => NK ELV RECYCLING) Min 15"Lorsqu'on fait des grandes campagnes d'avertissement sur le triage, on voit directement le taux de mauvais dans les sacs baisse considérablement, jusqu'à 10 15%. Maintenant la plupart du temps c'est plutôt autour de 25%."
Janek Vähk	Mn 6:45"Minimize as much as possible residual waste and its hazardouness of the waste." Mn 7"Preserve ressources as much as possible, keeping ressources on the loop so minimize as much as possible landfilling and incineration " Mn 9 "Product and packaging desgin should be thought in a way that when thrown it's not turn into hazardous material" Mn 11:30 "There are few incentives to sort out waste in households." Min 12:40 " It's a problem of infrastruce to recycle as much as possible" Min 13 "A lot of recyclable waste ends up being incinerated, being treated as residual waste" Mn 15:20 " Local policies should be implemented in a way that there is all the infrastructure to recycle waste" Mn 16 "Awarness of people is important but we should have incentives to sort out correctly their waste" Min 16:55 " UP to 75/85 % of residual waste is recyclable but it's not being sorted out or treated correctly (incinerated or put in landfills" Mn 18 "Infrastructure is not present but also market incentives are not present in a way that we put more value in recycling, so we prefer to treat it as residual waste. Improve infrastructure in a way that we can reintroduce waste as much as possible into the loop"
Maxime Pernal	Mn 10:55 : "Première chose c'est la prévention, l'idéal c'est de ne pas produire le déchet" "le meilleur déchet c'est celui qu'on ne produit pas" Min 11:20 : "La qualité du déchet est primordial pour le recyclage" "Recyclage c'est la première étapge d'une gestion circulaire des déchets mais la qualité de ces déchets est primordiale parce que recyclé uniquement en regardant la quantité de déchets que l'on peut recyclé c'est bien mais c'est très vite limité" Min 11:55 " Est ce qu'on veut recyclé un plastique qui contient des additifs qui sont dangereux pour la santé humaine, du papier avec du bisphénole A" Min 12:20 "Quand on commence à avoir des déchets qui sont des assemblages de matières mixtes (papiers, plastiques, encres) c'est un problème en amont, de designs de produits... Il faut savoir ce que l'on met dans ce cercle pour qu'on puisse le réutiliser correctement par la suite: Pour la santé humaine et pour l'environnement" Min 15 "Tout un systuème qui nécessaire pour une économie circulaire, c'est de la prévention, du design, garder la qualité, séparation à la source et séparation en centre de tri et il faut quelque chose qui s'occupe de garder le système propre. Comme dans un corp nous avons des reins, un foi, dans la gestion des déchets il faut un système qui s'occupe de débarasser ce que l'on ne veut pas. Là on a plus trop le choix, on a l'incinération avec récup d'énergie, on a les décharges et ensuite les dépôts sauvage" Mn 15:15 "Est ce que c'est raisonnable et intelligent de chercher un produit qui est techniquement favorisable mais finalement il n'y a pas de marché, de demande pour ce matériel final... Pour une gestion circulaire des déchets, il faut conjuguer une stratégie d'élimination des déchets, il faut que le coût pour le citoyen soit raisonnable, il faut que l'on sorte des produits qui soit soummis à une loi du marché des matières secondaires avec des indices de prix qui descendent et qui baissent" Min 16:30 "Il y a des polluants organiques persistants que lorsqu'on met en décharge ca va polluer inévitablement les sols" Mn 64: 15 " Le tri du déchet correct. Le meilleur moyen d'avoir une bonne qualité de recyclage c'est le tri à la source
Wouter Achten	Mn 10:55 : "Première chose c'est la prévention, l'idéal c'est de ne pas produire le déchet" "le meilleur déchet c'est celui qu'on ne produit pas" Min 11:20 : "La qualité du déchet est primordial pour le recyclage" "Recyclage c'est la première étapge d'une gestion circulaire des déchets mais la qualité de ces déchets est primordiale parce que recyclé uniquement en regardant la quantité de déchets que l'on peut recyclé c'est bien mais c'est très vite limité" Min 11:55 " Est ce qu'on veut recyclé un plastique qui contient des additifs qui sont dangereux pour la santé humaine, du papier avec du bisphénole A" Min 12:20 "Quand on commence à avoir des déchets qui sont des assemblages de matières mixtes (papiers, plastiques, encres) c'est un problème en amont, de designs de produits... Il faut savoir ce que l'on met dans ce cercle pour qu'on puisse le réutiliser correctement par la suite: Pour la santé humaine et pour l'environnement" Min 15 "Tout un systuème qui nécessaire pour une économie circulaire, c'est de la prévention, du design, garder la qualité, séparation à la source et séparation en centre de tri et il faut quelque chose qui s'occupe de garder le système propre. Comme dans un corp nous avons des reins, un foi, dans la gestion des déchets il faut un système qui s'occupe de débarasser ce que l'on ne veut pas. Là on a plus trop le choix, on a l'incinération avec récup d'énergie, on a les décharges et ensuite les dépôts sauvage" Mn 15:15 "Est ce que c'est raisonnable et intelligent de chercher un produit qui est techniquement favorisable mais finalement il n'y a pas de marché, de demande pour ce matériel final... Pour une gestion circulaire des déchets, il faut conjuguer une stratégie d'élimination des déchets, il faut que le coût pour le citoyen soit raisonnable, il faut que l'on sorte des produits qui soit soummis à une loi du marché des matières secondaires avec des indices de prix qui descendent et qui baissent" Min 16:30 "Il y a des polluants organiques persistants que lorsqu'on met en décharge ca va polluer inévitablement les sols" Mn 64: 15 " Le tri du déchet correct. Le meilleur moyen d'avoir une bonne qualité de recyclage c'est le tri à la source

Matrix Table #1: Question 2 & 3

Interviewees	2° When it comes to a circular Municipal Solid Waste management system, do you believe Waste to Energy technologies are inevitable?	3° According to you, can WtE technology be considered as a renewable source of energy?
Sofia Figueiredo	Min 43 "Incineration works until a certain extent, because is not the most environmentally friendly solution available. But you do need incineration when treating hazardous material and waste" Min 44 "Yes we need waste to energy technologies for circular waste management" Min 46" Incineration nevertheless should be our last option"	Min 55:40 "Yes, WtE technologies can absolutely be considered as renewable sources of energy. There are always CO2 emissions in energy production activities, but when you realise the amount of energy you can produce with these technologies, it has less negative impact than if you produce new energy from scratch" Min 56 "For it to work, everything has to be sorted out very well"
Alain Maubert		
Gérald Valay	Mn 1: "Certe oui mais c'est à regarder en fonction du gisement du déchet, de la situation de la population… On est pas dans quelque chose aussi simple que ca. Il y a certe des déchets qui ne sont pas recyclable" Min 20 "Une usine d'incinération fonctionne pour bruler un certain tonnage donné. Si tu enlève de ton usine des déchets que tu valorise, tu va avoir des nouvelles filières de déchets qui doivent arriver pour combler ce manque" Min 21:50 "Si tu n'amène pas les déchets necessaires, sont bilan economique et energetique n'est pas bon. Ils ont donc pas forcément un intérêt à ce que l'on développe des centre de tri encore plus développer ou dvlper des plus de filières de valorisation de déchets"	Min 22 "ca dépend de l'endroit ou l'on se trouve mais oui c'est nécessaire"
Georges Dumbruch	Min 12:30 "Il y a une partie qui ne peut être recyclé ou réutilisé, donc ils devraient être incinérés"	Min 18:45 "Comme il y a aura toujours des déchets qui devront être brulé, il faut faire en sorte de les valoriser le mieux possible. Le chauffage urbain semble être la manière la plus efficace de le faire. Lors de la production d'electricité, on terme d'éfficacité de production on en est pas encore là" Min 20:15 "Oui, on peut produire de l'hydrogène, capter du CO2 et en faire de métanol" Min 28 "On injecte dans le réseau l'équivalent de 65 mil ménages. 10 à 14% de l'energie qu'on produit est utilisé dans l'usine, le reste c'est pour les consomateurs." Min 29 "L'équivalent de plus de 95% des déchets qui arrivent de l'incinérateur est favorisé. Que ce soit pour alimenter des ménages en chaleur, ou bien extirper de la féraille, sel pour faire du bicarbonate de soute industriel..". (plein de débouchés...)
Janek Vähk	Mn 20 " It's not like you must have it" Mn 20:30 "300 to 500 million euros for a waste incineration plant so not every country has a incineration plant" Mn 21:40 "If we are talking about circular waste management when you minimize waste and residual material waste, you could have a future where we don't need incineration" Mn 23 "When you have an incinerator you need waste to make it work so you keep feeding it which is not a great incentive to find other solutrions and work towards a more circular economy" Mn 23:45 "When we identify a package or product that we can not recycle we should review the production of that product instead of keep manufacturing it and treat it as such" Mn 26;30 "You need to thik in a future where we limit waste being incinerated and limiting only for hazardous waste. Non hazardous should not be incinerated"	Mn 28:45 "It's not sustainable to keep burning our ressources" Mn 31:30 "We should not consider incineration as a renewable energy" Mn 32 "Biowaste is different because it can improve sorting out and hazardous spillage and can have a great benefit wihth processes like methanization" Mn 33:30 " Organic waste is definitely interesting and could be consider as renewable." Mn 36:10 "Incineration can not be considered as renewable" Mn 37 'Anaerobic digestion is 20 times more efficient of energy for bio waste recovering than incineration"
Maxime Pernal	9mn 15 "Autour de 50% des déchets incinérés dans l'incinérateur sont des déchets industriels et commerciaux" Mn 13:45 "Combien d'énergie il faut pour recycler un déchet (eau, electricité, solvent…). Si le coût environmental est plus élevé de le recyclé que de pas le recyclé, la question doit se pauser. C'est une question aussi qui se pause au niveau financier et politique aussi! Combien ca coûte ou bien on le recycle même si c'est pas la solution la moins chèr" Min 14:05 "L'incinération avec récupération d'énergie est nécessaire dans une économie circulaire car l'on a tout ces déchets que l'on ne veut pas recyclé" Min 15 "Tout un systuème qui nécessaire pour une économie circulaire, c'est de la prévention, du design, garder la qualité, séparation à la source et séparation en centre de tri et il faut quelque chose qui s'occupe de garder le système propre. Comme dans un corp nous avons des reins, un foi, dans la gestion des déchets il faut un système qui s'occupe de débarasser ce que l'on ne veut pas. Là on a plus trop le choix, on a l'incinération avec récup d'énergie, on a les décharges et ensuite les dépôts sauvage" Min 16:30 "Il y a des polluants organiques persistants que lorsqu'on met en décharge ca va polluer inévitablement les sols" Min 17:40 "Dans beaucoup de cas on détruit les polluants, on réduit la quantité de volume (une partie des cendres peuvent être réutilisés) considérable par rapport aux décharges, on concentre les déchets que l'on ne veut pas et ainsi s'assurer d'élimer et traiter correctements ces componants au lieu de les diffiuser en voulant à tout prix recyclé dans le cycle et matériaux réutiliser" Min 18:40 "Des solutions différents sont présentes : Incinération avec récup d'nergies, pyrolisie gasification, digestion en anaerobie. C'est au niveau politique local de prendre la décision en fonction des capacités locales en fonction de quelle déchet on veut traiter dans les 10, 15, 20 prochaines années..." Min 21 "LEs gens vont s'opposer aux incinérateurs mais pas au centre commercial qui est à côté. Ce n'est pas l'incinérateur qui	Min 23:40 "C'est une technologie qui s'améliore énormément surtout au niveau des nettoyages de fumé. Bien sur il y a un impact au niveau CO2 car il y a combustion par contre niveau fumés toxiques il y a aucun impact dangereux pour la santé, maintenant on se concentre à nouveau à améliorer la récupération d'énergie. Avec moins de déchets produire plus d'energie" Min 26" En europe, si le directeur d'un incinérateur ment sur les chiffres de son incinérateur c'est une infraction et on risque la prison donc on prend pas de risque avec la santé des gens" Min 27:15 "C'est déjà considére en partie comme une énergie renouvelable. Bien évidemment ca dépend de la définition que l'on y applique. Au niveau européen l'energie renouvelable ca correspond à la biomasse. Le carbonne qui va etre rejeté par l'usine, profuit par la combustion de déchet, a de toute facon un poid de carbonne. Inévitablement ce déchet aurait produit du carbonne mais ici on a fait de la récup energetique" Min 29:30 "Tout ce qui va etre d'origine naturelle on considère ca dans une dimension légale comme renouvelable car de toute facon ca aurait produit du carbonne (cuir, coton, papier qui ne peuvent être recyclé" "Par contre pour le plastique NON" Min 30" La législation est claire. L'energie produite à partir de combustion de déchets d'origine organique, c'est une énérgie renouvelable. Cette partie là des déchets" mn 33:30 "Le déchet si il n'y a pas d'incinération où est ce qu'il va ? si il va en décharge, si il est d'origine biogénique, ca va produire du méthane qui est lui c'est entre 24 ou 28 fois plus importante que le CO2 sur le réchauffement climatique. Pour les déchets qui ne sont pas nécesssairement biogénique et qui ne produisent pas de méthane, ils ne sont pas propres non plus donc peuvent contaminer le cycle. Ici on va produire de l'energie avec quelque chose qui n'avait pas de valeur à la base" Min 35:20 "On va récupérer des minéraux qui nous permette de remplacer le sable qui est nécessaire pour des constructions lourdes (comme le gravier), on va récupérer des métaux qu'on pourrait pas extraire autrement qu'après incinérations de déchets complexes"
Wouter Achten	Mn 48 "On produit des déchets avec lesquelles on ne sait plus rien faire et donc dans ce cas là l'incinération avec récup d'énergie est plus intereesante que mettre en décharge. Dans ce contexte là c'est inévitable et plutôt efficace" Mn 49 "Dans la réalité dans laquelle on se trouve, c'est plutôt le cas. Mais ca ne devrais pas être un argument pour continuer à fabriquer ce genre de déchets. Ces déchets ne devrait pas être fabriqué et si dans un futur on a plus ces déchets résiduels et on perd les incinérateurs, c'est mieux" Mn 50 "Les déchets organiques réduise la chaleur produite dans les incinérateurs car ils sont remplis d'eau. Si on collecte tout les déchets organiques de manière séparés pour etre biométhanisé on va : 1/ Aura moins de déchets à bruler 2/ On va avoir encore plus de chaleur dans les incinérateurs" Mn 57:30 "On peut et on doit réduire le plus possible les déchets incinérés" Mn 60 " Ca prendra encore bcp de temps à nous défaire de ces déchets résiduels. De plus il y a une fin à la recyclabilité d'un produit. Il y a des limites à nos ressources, on peut recyclé jusqu"à certain point. Il y a des impurities tout au long du cycle, donc qu'est ce qu'on devrait faire ajd. Les enfouir pour voir si on peut les recycler dans le futur ou bien les incinérer" Mn 63:30 "C'est difficile à imagine mais on peut fortement réduire l'incinération mais ca nécessite de l'investissement tout au long de la boucle, afin de moins incinéré"	

Matrix Table #1: Question 4 & 5

Interviewees	4° Do you believe that there is an influence of the development of Incineration technologies on the expansion of Recycling Technologies?	5° In your opinion, what do you think might be the main technological, logistical and business related opportunities when it comes to improving waste management systems towards more circular schemes? (e.g. the development of specific material treatment plants, household waste sorting, different waste collection systems…) And more specifically for the Brussels Capital Region?
Sofia Figueiredo	Min 46:50 "WtE plants walk more hand in hand with recycling facilities but not incineration." Min 48:45" You will always need incineration for the waste you can't valorise or recycle. But you should always put the priority on recycling as much possible so that you sort out as much as possible what you valorise and finally, if necessary, incinerate" Min 51:30 "It's easier to invest in something that you know and has been going on for years instead of trying something new that you're not really sure if it's going to work" Min 53 "Incinerators are not the answer" Min 55: "If we still invest in Incineration, we are still investing in air polluting technologies"	Min 27 "A lot of household waste is organic, there is a lot to do around valorisation of this type of waste" Min 60:01: Talks about the adavantages and the opportunities of organic waste treatment Min 60:03 "Organic waste treatment facilities are the biggest opportunities in Europe" Min 60:05 "Organic is one of household waste that can be the most valued" Min 60:10 "solutions regarding organic food waste"
Alain Maubert		Min 0:30" Je choisi mes projets de deux manières, soit j'ai un client qui a un besoin de matière dans ce cas je cherche les déchets pour produire cette matière. Soit j'entend parler d'un gisement de déchets orphelins ou je trouve un sourcing significatif de ces déchets que je peux traité" Min 14:10 'Lorsque je cherche des opportunités commerciales, j'agis sur 3 tableaux: Il y a le sourcing, les moyens industriels, les besoins des clients en matière de plastique recyclé" Min 16: "Système de triage optique automatisé sont très solicités pour pouvoir trier plus spécifiquement des déchets qui requiers des triages plus spécifiques, comme le plastique" Min 24:30 "Le déchet est une matière au même titre que n'importe quelle autre matière que l'on éxtrait du sol, il n'y aura de véritable dynamique que lorsqu'il y aura une véritable rentabilité économique de ce gisement" Min 25 "Il y a un gros boulot à faire sur tout les déchets électroniques. Il n'y a pas besoin de beaucoup d'espace et il ne semble pas être un déchet à hautes dérivés dangereuses" Min 31:55 "L'éco conception dans son accepation la plus globale est determinant pour l'industrie. Après les technologies qui aide à trier et identifier les déchets" Min 42:50 "Faire des points de ventes de stock en vrac pour les produits rechargeables. Tout l'investissement dans le produit et sa qualité, et non dans l'embalage."
Gérald Valay	Mn 1: "Certe oui mais c'est à regarder en fonction du gisement du déchet, de la situation de la population… On est pas dans quelque chose aussi simple que ca. Il y a certe des déchets qui ne sont pas recyclable" Min 20 "Une usine d'incinération fonctionne pour bruler un certain tonnage donné. Si tu enlève de ton usine des déchets que tu valorise, tu va avoir des nouvelles filières de déchets qui doivent arriver pour combler ce manque" Min 21:50 "Si tu n'amène pas les déchets necessaires, sont bilan economique et energetique n'est pas bon. Ils ont donc pas forcément un intérêt à ce que l'on développe des centre de tri encore plus développer ou dvlper des plus de filières de valorisation de déchets"	Mn 8 "Actuellement on a pas la structures necessaires, elle est sous dimensionné par rapport aux déchets que l'on a. Du coup tout bruler dans des incinérateurs ca semble beaucoup plus attirant, mais est ce que dans la situation actuelle on a vraiment le choix? On a eu un comportement en Europe ou on a mis en place des legislation de restriction des mises en decharge, de taux de recyclage minimum mais on a pas soutenu le developement de l'infrastructure nécessaire pour atteindre cette réalité" Mn 30:30 "L'Europa a eu un comportement complètement irresponsable dans les 95s jusqu'à nos jours se retrouve sans outils industriels pour retraiter ses déchets et les recyclés, et sans exutoire à l'étranger pour y aller. C'est dans se sens qu'il y aura des opportunités commerciales en Europe dans les années à venir" Mn 33 "Dans le recyclage tu a deux choses: Tu a le trie des ordures, qui peuvent être soit collecté par du porte à porte, soit par du trie ménagere brute (tu la secoue, tu regarde et tu prend le plus possible pour essayer de valoriser ce que tu peux). Pour la plupart des pays européen, on a des centre de tri à peut près partout! Mais ce qui manque derriere c'est le centre de recyclage, l'infrastructure pour traiter la matière trier. C'est c'est usine de fabrication de matière que l'on a très peu. Il n'y a pas assez de filière de traitement de déchets" Mn 83:50 "Tout ce qui est verre me semble être la filière la plus circulaire, le verre est un produit qui est réutilisable à l'infini, c'est facile à trier, il y a de la possibliité de consifgne" Mn 86 " Fer et 'aluminium en recyclage a un prix interessant, ils sont facile à recycler on utilise pas autant d'energie que pour les fabriquer elles meme, ce qui les rendent economiqueemtn interessante" Mn 89 "Le problèeme est néanmoins le problème principale. On a du mal a se passer du plastique, il faudrait fabriquer des emballages constituer de monoplastiques au moins"
Georges Dumbruch	Min 1:40 "Tout les pays qui ont des grands taux de recyclage on des taux d'incinération important. L'incinération est complémentaire d'un tri convenable des déchets." Min 2:40 "L'idée que l'incinération bloque le dvlpmt du recyclage est fausse" Min 32"Aujourd'hui, deux tiers des déchets incinérés provient des ménages, le reste vient des industriels, des commerces... Il y a 20 ans, presque 100% provenait des ménages, mais on a fortement diminué les déchets provenant des ménages dans la mesure que le recyclage augmentait. Le kg par habitant n'a pas beaucoup changé en 20 ans, c'est juste que la fraction de recyclage des dechets menagers a beaucoup augmenté et l'incinération a baissé." Min 39:15 "Le fondamental c'est de trier à la source! Mettre en décharge pollue encore plus l'air et les solo que les incinérés. Mettre en décharge c'est aussi beaucoup moins cheres que mettre en place des centres d'incinérations qui valorisent ces déchets" Min 41:50 "Personne n'est interessé de tout mettre à l'incinérateur en Belgique. C'est pour cela que la Belgique est un des pays européens qui recycle le plus"	Min 13:05 "L'habitat et le transport sont nos plus gros challenges en terme d'energie. On nous impose des taux d'ultisation d'energie à provenance renouvelables qui sont considérable, jusqu'à 50%" Min 15:45 "Il y a une opportunité considérable à développer des filières spécifiques de traitement et d'utilisation de plastiques." Min 33:15 "Valorisation des dechets organiques est une opportunité considérable à prendre en compte qui va dans le respect de la gestion circulaire des déchets" Min 35 "On a organisé la collecte des déchets organiques à Bruxelles pour se faire une idée du tonnage de ce type de déchets dans la ville et ce que l'on jette exactement pour faire un cahier de charge et eventuellement construire une usine de bio métanisation." Min 59 "Plus de filière de valorisation de pour le plastique, plus spécifiques" 63:30 "Conscientisation et sensibisation des gens" 64:15 "Compostage commun par commune" 65: "Developement des filières de recyclages electronique. Faire une base de donnée commune pour comment réparer leurs appareils" 66:40 "Il faut arreter de voir le dechet comme une etape mais plutot remonter la filière et repenser comment on concoit nos produits"
Janek Vähk	Mn 40:30 "Incineration ends up undermining recycling" Mn 23 "When you have an incinerator you need waste to make it work so you keep feeding it which is not a great incentive to find other solutrions and work towards a more circular economy" Mn 42 "There are statistics showing than when they open an incinerator waste being recycled reduces. Also we can't forget that when there is an incineration plant they actually end up burning recyclable waste" Mn 42:50 "There is a corrolation. Incineration ends up undermining recycling"	Mn 45:40 "Zero waste shop, packaging free shops " Mn 45:30 "A lot of potential for DRE" Mn 48 "Bio waste treatment plant" Mn 48:45 "Develop better incentives for better separation" Mn 49:45 "Reuse becease recycling is not enough"
Maxime Pernal	Mn 50:30 "Qui arrive au centre de tri est qui est pas recyclable c'est à la hauteur de 20 à 25%" Min 54:30 "Les technologies d"incinération n'est plus trop entrain de s'étendre car ce sont des technologies qui sont déjà installés depuis longtemps et les prérogatives européennes ne poussent pas réellement à ces dernières" Min 55:20 "Les pays qui recyuclent le plus en Europe ce sont des pays qui repose sur l'incinération. Les pays qui ont réussis à passer les 50% de recyclages en Europe se reposent tous sur l'incinération. Dès qu'on arrive à 60% c'est très dure de faire sans incinération." Min 57:45 " Au Portugal il n'y a quasiment pas d'incinération par contre on est à 30% de recyclage et presque 50% de mise en décharge" "Je ne vois que la Slovénie ou il y a un haut tx de recyclage sans présence d'incinérateurs, c'est la seule exception" Min 54:30 "L'incinération n'est pas une technologie à laquelle on opte aujourd'hui, ou l'on voit que ca se développe globalement. Cependant, si on voit globalement en Europe, les pays qui recicient le plus ce sont des pays qui se reposent de l'incinération". Min 56:20 "Si ces pays ont réussis à obtenir plus de 50% de recyclages, c'est très difficile de continuer à augmenter le taux de déchets recyclés. Ce sont généralement les pays qui recyclent le plus qui s'appuie sur les technologies d'incinérations. Portugal par exemple ne s'appuie pas sur l'incinération et ils ne recyclent que 30% de leurs déchets, ils s'appuient principalement sur la mise en décharge, près de 50%!" Min 58:50 "Si vous voulez un bon recyclage, il faut une bonne qualité de produit qui rentre, qui nécessite un bon triage en amont! " Min 62 "C'est souvent les mêmes acteurs qui s'occupent d'implémenter des technologies d'incinérations qui s'occupent du triage, du recyclage… c'est le cas au Portugal, lipor s'occupe de l'incinération à Porto ainsi que le recyclage"	Min 44 "Recyclé 65% et mettre en décharge 10% ca veut dire qu'il faut récolter beaucoup de déchets et être capable de traiter ces déchets résiduels qui ne peuvent aller en décharge ni etre recylé. Recyclé 65% ca veut dire que l'on doit récupérer 80% des déchets environ car il y a toujours 15/20% collectés qui ne pourrons pas ête recyclés. On voit qu'il n'y aura pas assez de capacité de traitement pour ces déchets résiduels, ca ne veut pas dire que l'on doit faire de l'incinération non plus." Min 47 "Il y a besoin de capacité de traitement pour ces déchets résiduels si l'on veut atteindre ces objectifs" Min 43:15 "D'ici 2035, la mise en décharge devrait être à 10% maximun par pays, ce qui est très stricte pour certain pays! ca ouvre une énorme fenetre de travail à faire pour developper des filières de traitement de ces déchets, pour l'instant on a pas assez de capacités de traitement pour ces déchets residuels" Min 47 "Il y a besoin de capacité de traitement pour ces déchets résiduels" Min 51:50 "La difficulté avec Bruxelles c'est qu'il y a beaucoup de passage de personnes qui habitent pas vraiment ici et ne sont pas au courant de comment trier correctement. Il y a beaucoup de personnes qui ne sont pas vraiment éduquer à correctement trier leurs déchets, souvent due aux disparités, inégalités, socio culturelles présente dans la région. Centaine de nationalité qui cohabitent ensemble, c'est difficile de communiquer la bonne information universellement Min 66:25 "Principalement l'éducation, on pourrait recyclé plus à Bruxelles, recuperer plus de materiel, avoir des flux plus propres, si les gens sont plus conscient de ce qu'il mettre dans les sacs" Min 68:30 "La consomation homologué au zero waste" Min 69 "Travail à faire sur le design des produits en eux mêmes"
Wouter Achten		Mn 20:20 "Probablement de la profitabilité dans la gestion des déchets organiques et probablement dans la gestion des déchets electroniques" Mn 26:30 "La concentration de métaux est plus elevé sur une tonne de déchets electronique que dans une mine naturelle" Mn 26:45 "Il y a probablement sur chaque étape de la boucle des opportunités commerciales parle de collecte, traitement, sensibilisation" Mn 27:40 "Le role d'une ville comme bruxelles c'est plutot la Préparation pour une circularité à un niveau plus élevé, plus globale, il y a plus à faire qu'essayer d'être circulaire absolument à bruxelles. On prépare par exemple après incinération la récupération des métaux mais pas le traitement des métaux au sein de bruxelles. La PREPARATION À LA CIRCULARITÉ ÉST IMPORTANTE À FAIRE À BRUXELLES" Mn 34:30 "Ouvrir un centre de biométhanisation est une vraie opportunité pour la vile de Bruxelles. On perd tout les nutriments en incinérant nos déchets organiques. Avec la biométhanisation on récupère bcp plus d'energie que l'incinération" Mn 40:25 "Opportunités de préparer pour le recyclage à bruxelles. Le démentellement par exemple. Des opportunités d'économie sociales aussi! " Mn 43 'Opportunité d'économie sociale pour le démentelement des déchets electroniques" Mn 67:30 "Je pense qu'il y a des opportunités sur chaque étapes mais ca dépend de quel type de déchet. " Mn 68 "Pour la collecte des déchets il y a quelque chose à offrir" Mn 68 "Dans le traitement et pré traitement surtout si on mélange avec de l'économie sociale"

Matrix Table - Results #2: Question 1

	1° In your opinion, what are the main characteristics of a circular waste management system?
Interviewees	Characteristics of a circular Waste Management System
Sofia Figueiredo	5° Raising awareness 2° Thorough sorting and collecting 4° Preserve ressource & Reduce waste 1° Sustainable design 3° Legislation : market incentives & sanctions
Alain Maubert	1° Sustainable design 3° Legislation : Marjet incentives & sanctions 6° Exhaustive waste treatment channels
Gérald Valay	4° Preserve ressources & Reduce Waste 1° Sustainable design 3° Legislation : Market incentives & sanctions 2° Thorough sorting and collecting 6° Exhaustive waste treatment channels
Georges Dumbruch	2° Thorough sorting and collecting 5° Raising awareness 1° Sustainable design 3° Legislation : Market incentives & sanctions
Janek Vähk	4° Preserve ressources & Reduce waste 1° Sustainable design 3° Legislation : Market Incentives & sanctions 2° Thorough sorting and collecting 5° Raising awareness 6° Exhaustive waste treatment channels
Maxime Pernal	5° Raising awareness 2° Thorough sorting and collecting 6° Exhaustive waste treatment channels 3° Legislation : Market Incentives & sanctions 1° Sustainable design
Wouter Achten	4° Preserve ressources & Reduce waste 1° Sustainable design 2° Thorough sorting and collecting 5° Raising awareness 6° Exhaustive waste treatment channels 3° Legislation : Market Incentives & sanctions

1° Sustainable design	**Sofia Alain Gérald Georges Janek Maxime Wouter**	**7**
2° Thorough sorting and collecting	**Sofia Gérald Georges Janek Maxime Wouter**	**6**
3° Legislation : Market Incentives & sanctions	**Sofia Alain Gérald Janek Georges Maxime Wouter**	**7**
4° Preserve ressource & Reduce waste	**Sofia Gérald Janek Wouter**	**4**
5° Raising awareness	**Sofia Georges Janek Maxime**	**5**
6° Exhaustive waste treatment channels	**Alain Gérald Janek Maxime Wouter**	**5**

Matrix Table - Results #2: Question 2, 3 & 4

	2° When it comes to a circular Municipal Solid Waste management system, do you believe Waste to Energy incineration is inevitable?	3° According to you, can WtE incineration technology be considered as a renewable source of energy?	4° Do you believe that there is an influence of the development of Incineration technologies on the expansion of Recycling Technologies?
Interviewees	Role and impact of WtE incineration for residual waste in a CWMS		
Sofia Figueiredo	2° Yes, moderatelly agree	3° No, don't agree	1° Yes, there is an influence
Alain Maubert	2° Yes, moderatelly agree		
Gérald Valay			1° Yes, theres is an influence
Georges Dumbruch	1° Yes, strongly agree	2° Yes, moderatelly agree	2° No, they go hand in hand
Janek Vähk	3° No, don't agree	3° No, don't agree	1° Yes, theres is an influence
Maxime Pernal	1° Yes, strongly agre	1° Yes, strongly agree	2° No, they go hand in hand
Wouter Achten	3° No, don't agree		

1° Yes, strongly agree	**Maxime Georges**	**2**	**1° Yes, strongly agree**	**Maxime**	**1**	**1° Yes, there is an influence**	**Sofia Janek Gerald**	**3**
2° Yes, moderatelly agree	**Gérald Sofia Wouter**	**3**	**2° Yes, moderatelly agree**	**Georges**	**1**	**2° No, they go hand in hand**	**Georges Maxime**	**2**
3° No, don't agree	**Janek Wouter**	**2**	**3° No, don't agree**	**Janek Janek**	**2**			

Matrix Table - Results #2: Question 5 & 6

	5° Taking into consideration the Lensink Ladder, otherwise known as the "waste hierarchy", in which steps do you believe there are the most business opportunities?	**6° In your opinion, what do you think might be the main technological, logistical and business related opportunities when it comes to improving waste management systems towards more circular schemes? (e.g. the development of specific material treatment plants, household waste sorting, different waste collection systems…) And more specifically for the Brussels Capital Region?**
Interviewees	Business opportunities leading towards a more circular Municipal Solid Waste treatment	
Sofia Figueiredo	3° Recycling 4° Recovery	1° Organic Waste treatment facilities
Alain Maubert	1° Prevention 3° Recycling	2° Plastic treatment 4° Sorting technologies and facilities 5° E-waste treatment 6° Sustainable design 7° Deposit Return Scheme Development
Gérald Valay	3° Recycling 4° Recovery	1° Organic Waste treatment 2° Plastic treatment 3° Waste collecting solutions 4° Sorting technologies and facilities 5° E-waste treatment 6° Sustainable design
Georges Dumbruch	1° Prevention 3° Recycling	1° Organic Waste treatment 2° Plastic treatment 5° E-waste treatment 8° Raise awareness 6° Sustainable design
Janek Vähk	1° Prevention 2° Reuse 3° Recycling	7° Deposit Return Scheme Development 6° Sustainable design 1° Organic Waste treatment 8° Raise awareness 9° Reuse/Repair
Maxime Pernal	1° Prevention 3° Recycling 4° Recovery	5° E waste treatment 4° Sorting technologies and facilities 2° Plastic treatment 8° Raise awareness 3° Waste collecting solutions 6° Sustainable design 7° Deposit Return Scheme Development
Wouter Achten	3° Recycling	1° Organic Waste treatment 5° E-waste treatment 3° Waste collecting solutions 4° Sorting technologies and facilities 6° Sustainable design

1° Prevention	**Alain Georges Janek Maxime**	**4**	**1° Organic Waste treatment**	**Sofia Gérald Georges Janek Wouter**	**5**
2° Reuse	**Janek Georges**	**1**	**2° Plastic treatment**	**Alain Gérald Georges Maxime**	**4**
3° Recycling	**Sofia Alain Gerald Georges Janek Maxime Wouter**	**7**	**3° Waste collecting solutions**	**Gérald Maxime Wouter**	**3**
4° Recovery	**Sofia Gerald Maxime**	**3**	**4° Sorting technologies and facilities**	**Alain Gérald Maxime Wouter**	**4**
5° Disposal		**0**	**5° E-waste treatment**	**Alain Gérald Georges Maxime Wouter**	**5**
			6° Sustainable design	**Alain Gérald Georges Janek Maxime Wouter**	**6**
			7° Deposit Return Scheme Development	**Alain Janek Maxime**	**3**
			8° Raise awareness	**Georges Janek Maxime**	**3**
			9° Reuse/Repair initiatives	**Janek**	**1**