

IMPACT STRATEGY MISSION

HEC ENTREPRENEURS

Reduction of household waste : Single-use plastic packaging waste in the takeaway industry.

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Abstract

In 2015, the ONU set out 17 sustainable development goals. Those are urgent calls to action that all countries, in a common effort, must act on to ensure a sustainable future. Behind those goals, several problematics need to be addressed and combined with entrepreneurship initiatives to build an impact strategy. Waste due to our consumption habits is touching on the objectives 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), and 13 (Climate Action). The detailed study of those wastes led us to realise the importance of plastic in the waste streams from any Walloon household. Being the material with the lowest recycling rate made it another argument for deepening our understanding of this waste stream.

Not all plastics are the same, and all have a different negative impact. Single-use plastic stands very high in people's opinion as something to get away from. An example where those are very frequently used is in takeaway packaging. Single-use plastic containers are well established in the catering industry. This stream of waste on its own is highly environmentally damageable due to the low recyclable potential plastic used, the lack of appropriate sorting, leakage into the environment, poor energy conversion, and weaknesses in the recycling cycle. Yet, thanks to their wide range of design, functional properties, and low cost, plastics are still a solution that is preferred in most cases.

There is a willingness from people in the industry and a growing interest from their clients to move away from plastic. As long as it does not fully disrupt the current working way of the professional and still bring a similar cost implication and convenience to their clients, there are opportunities to change. Structuring ideas using Lansink's Ladder and exploiting the work on the circular economy for plastic from the MacArthur Foundation, helped to capture existing solutions and develop a value proposition. The 3 main pillars of actions, Reduce, Reuse, and Recycle, are covering a long list of solutions that exist or can be implemented. All of them need to be handled with care. Doing more damages than benefits with a potential solution can easily occur if not taking all the value chain and the rest of the life cycle of the solution into account. However, to maximize the impact, it appears that only a combination of actions that are strategically integrated with each other will bring to the most significant change.

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INTRODUCTION

In 2018, according to a report from the 'Etat de l'environnement Wallon' [1], the average Walloon produced 268 kg of household waste annually. From those 268 kgs, 54% (144.6 kg) were raw household waste when the other 46% (123.4 kg) were household waste collected selectively (glass, metals, plastics, paper,...). A study presented in Figure 1 shows the composition of the raw household waste (a) and the household waste collected selectively (b).

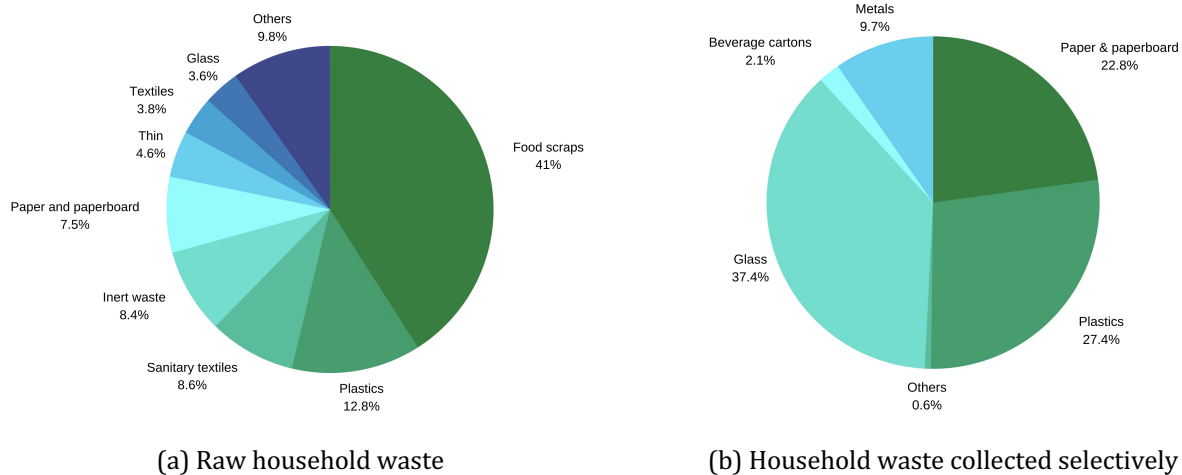


Figure 1: Composition of the household waste (2018) [2]

Figure 1 (a) shows that food scraps are the biggest category of waste found in the Walloon garbage with 41% of the total weight for the raw household waste. It is followed by plastics with 12.8%. While different alternatives are offered for the food waste (domestic compost, organic waste container and collect), no other possibility is offered to households for the disposal of their plastic waste. Unfortunately, any plastic found in the not for recycling household waste is either incinerated to provide electricity or end up in landfills.

In Figure 1 (b), plastics are the second biggest category of the household waste collected selectively with 27.4% of the total weight. When looking at the recycling rate of the different categories, the glass, paper & paperboard, and the metals are fully recycled, the beverage tetrapaks are recycled to 95.1%, and the plastics are recycled to only 43.1%. Even though the recycling rate of plastics is really low compared to other materials, it is interesting to note that Belgium has one of the best recycling rates of plastics in Europe [3].

Plastic is a thematic of concern, but not the entire ecosystem and related consequences can be studied within the course of the present work. The elaboration of a strategy for impact first starts by narrowing down the problematic to one of its facets. Only after defining the methodology to be used to push its understanding as far as possible, it was possible to start structuring the outputs. Mapping the challenge, the existing solutions, and the opportunities for action have finally opened the door to the enunciation of a relevant value proposition and potential solutions.

1 Project overview

1.1 Problematic

Despite the fact that plastic is one of the most present wastes in our garbage and its level of recycling is quite low, its functional properties combined with very affordable prices make it an easy choice when looking at a food container for example. The different plastics commercially available can be sorted within 7 main categories, as presented in Figure 2.

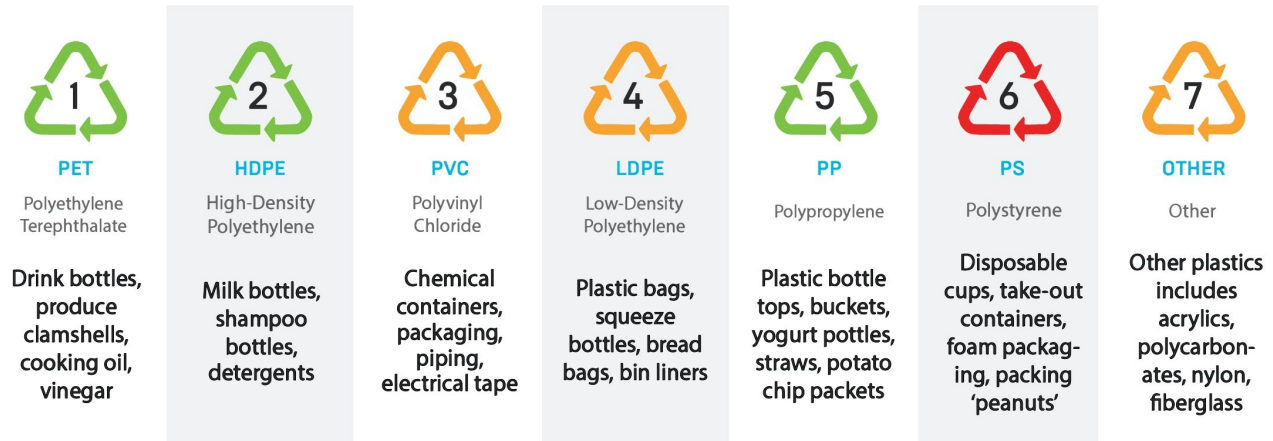


Figure 2: Different types of plastics [4]

Focusing on the plastics used in the foodservice industry, the takeaway containers are essentially made of polypropylene and polystyrene. This packaging primarily purpose is to contain the food sold, then the customer can conveniently take it away or get it delivered to his door. Thus, per design, they are meant to be used only once. Those single-use plastic packaging used in foodservice is thus rarely reused and end their life as waste after only a few hours of use. In the best-case scenario, they might well be treated appropriately and be brought to the right bin and finally recycled; but that is not the most common end to that story. The fight against plastic pollution has thus become a major societal concern. Citizens are mobilising and calling for a change in the production and consumption model to move away from single-use plastic and, more broadly, from 'disposable' plastic.

1.2 Ecosystem

To define how the problematic is structured, it is essential to see who are the different stakeholders taking part in this system. The life cycle of plastic foodservice packaging is fairly simple to understand. Plastic is produced, mainly from co-stream of crude oil distillation even if some are biobased. Then this raw plastic is turned into food packaging by a packaging producer. Once sold to the foodservice business, it will be used to contain the food sold to the consumer. This latest can then put it in a recycling bin, where it will be collected, sorted based on the plastic used, and sent to a recycling company to be reused and start a new cycle. Otherwise, he might put it in the all waste bin, where it will be collected and incinerated. In the Walloon region and more especially in the Liege area, the main players of this chain could be represented as in Figure 3.

Of course, like any industry, there will be many dependencies and relations with other financial partners, legal bodies, NGOs, monitoring and research institutes, and well various commercial alliances, organizations, and other lobbyists; at regional, national, and European scale. In the context of the current report, the decision was taken to focus on the microcosm surrounding the catering, restaurant, and bars selling food in a takeaway package. While what is happening on a larger scale can have a direct or indirect impact, it did not seem relevant to pursue deeper in the details of the bigger picture but it is still something to take into consideration.

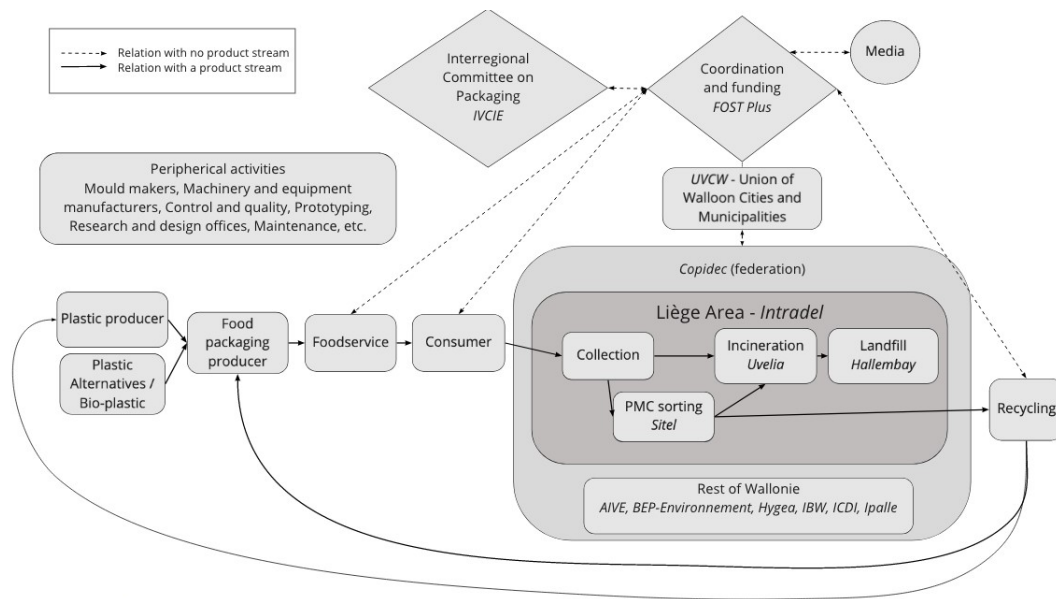


Figure 3: The plastic takeaway packaging value chain in the Liege area

1.3 Methodology

To better understand the pollution due to single-use plastic takeaway food packaging, two main activities area were carried out. On one hand, a collection of information available was done through desk research, and on the other hand, the gathering of insightful data was also made by interviewing experts of the problematic as well as people directly concerned, or tackling this issue. A list of the actors interviewed and their different roles can be found in the Appendix A: Persons interviewed. The purpose of the following report is first to best transcribe the understanding of the overall landscape surrounding this problematic. Then it aims to present an overview of actual or possible solutions. The framework used to guide the structure of the collected information and oriented the search is known as the Impact Gaps Canvas, originally developed by Daniela Papi-Thornton [5]. From there, a presentation of the key learning, insights, and gaps identified that need to be considered will be detailed to formulate potential solutions and their characteristics.

2 Impact Gaps Canvas: Challenge Mapping

Facing the issue of pollution due to single-use takeaway food packaging in the restaurants, coffees, hotels, and catering sectors is not a straightforward task. All angles of attack must take into consideration the system as a whole. Many players are involved, as direct players or supporting entities. Also, this problem relates to others through its consequences, even if some of them are less foreseen or expected. To an extreme, new problems could even arise if this issue is solved. Figuring out a way to get rid of single-use plastic might sound ideal yet, as plastic is made of a co-product of the crude oil

distillation process, optimised exploitation of newly generated waste stream would also have to be implemented. If considering a direct replacement of a plastic solution, this can lead to unintended consequences. Using glass, metal, wood, cardboard, or any other alternatives, if not taken in a holistic approach can be considerably damageable for people or for the environment. Potential repercussions can well be the increase in carbon emission, water use, or food waste.

Around 310 million tonnes of plastic waste were generated worldwide in 2016, a third of which ended up in the nature [6]. Soils, freshwater, and oceans are contaminated by macro, micro, and nano-plastics, which impacts wildlife and natural ecosystems. In addition, with the growth of food delivery services, most households in Belgium have access to food delivered right to their home. During this study, all the packaging identified in this context seems to be disposable. One single-use food packaging, depending on its composition, has an environmental impact of 15 to 35 CO₂eq [7]. Combined with the never-ending growth of the world population, along with the success of convenient food, it is estimated that in 2050, the global production and incineration of plastics, whether packaged or not, could emit 2.8 billion tonnes of CO₂eq per year. This is equivalent to the emissions of 615 coal-fired power plants [8]. The list can go on with an unclear effect on the health of certain additives that can be found in plastics such as BPA (bisphenol A) or PVC (polyvinyl chloride). Especially long term and 'cocktail' effects are hard to predict. As well, they can have an impact on the ecosystems, especially during plastic leakage (it is estimated that 225,000 tonnes of such additives are currently released annually into the ocean worldwide) or during its combustion [9].

2.1 Obstacles to change

Packaging is essential in the current consumer society and more specifically in the food sector. Indeed, it allows first to preserve food for a longer time. It protects the product from all external aggression but also from a neighbouring product. Packaging acts as a physical barrier between the food and the external world, which is necessary for safety. Then, it allows them to safely handle, transport, and store any product since the packaging cannot be opened before its consumption. After that, more importantly in retail and to a minor extent in a takeaway restaurant, it takes care of customer needs by informing legal mentions, precautions for use, and the ingredient list. It provides a service, helping the consumer to understand details of food preparation and consumption. Finally, this is a powerful marketing tool by making an easily recognizable product with identification, differentiation, and positioning, allowing to facilitate consumer's purchase [10].

The packaging is then offering a lot of benefits, this is why it has been used more and more for the last 50 years. Entry-level single-use plastics which demonstrate a cheap quality are not very resistant. But another higher-end is also available on the market are much more strong and rugged, allowing to withstand many different uses. By changing the design and the materials used, some can go in the freezer, in the microwave, and some compositions can go into the oven. All of this is possible while staying a very light material compare to its main rivals: glass and metal. Besides, its great benefit is to be an extremely economic material compare to all others. For example, a single-use polystyrene food box that cannot stand high or low temperatures retails around 4cts per unit and a rectangular microwavable and freezable polypropylene container retails around 14cts per unit.

Many actors stand to benefit from this type of plastic packaging. First of all, the consumer takes advantage of it since he is looking for simplicity. Indeed, whatever the place he goes to get his food, the consumer does not often have a reusable box with him. This could be because he did not think about it, he did not take the time to, or basically because boxes are too cumbersome for him. He may or may not be aware of more environmentally friendly ways to consume, but the easier to use and cheaper option

is for now still preferred. The consumer stays stuck in its habits and this is extremely difficult to change due to its lack of willingness.

Then, food producers are the main category of people taking advantage of this system. The reason is economic because disposable plastic packaging is actually the cheapest package on the market. As an example, at the caterers, a consumer will need around 3 to 4 different food containers. Then, it represents a budget for the trader that cannot be neglected in the long term. This is why the majority of them tend to use these disposable plastic packages, which are often more difficult to recycle. Also, this system is also easier for food orders since the caterer does not have to wait for the consumer. He can directly prepare the customers' orders and optimise his order preparation and logistic. Furthermore, mainly for small food businesses, using those plastic packages allow avoiding all logistical constraints. In addition, because main actors are small businesses, they are generally doing their accounting on their own; rarely being able to afford to work with an external expert. Then, they are not able to spend extra time taking care of the logistic and accounting of a deposit-return system for example.

Finally, most plastic production companies highly benefit from the current system and would have to face a potential loss in profit if things are changing. However, they were not the target of this study.

2.2 History and future of the challenge

Plastics trays have been around for a long time in the takeaway food packaging. In order to explain its history, one will focus on the fast-food restaurant chains since the evolution of both ecosystems are closely linked. More specifically, an example of focus is the biggest fast-food chain on the planet: McDonald.

McDonald's initially used paper packaging for its products when it opened in 1948. The first polystyrene cup was invented in 1941 and the first polystyrene 'sandwich' box in 1974. This new material quickly convinced the fast-food chain. Indeed, it had the advantage to maintain the food warm and avoid leaks which were one of the main disadvantages of paper. McDonald's then used massively polystyrene boxes by the 1980s, which became iconic of the early expansion of fast food culture [11].

Even though, McDonald's backtracked on those polystyrene boxes in the early 1990s and went back to paper and paperboard for the packaging of their products due to the pressure of the NGOs (NonGovernmental Organisations). If the move is an improvement, most packaging still in use contains a fraction of plastic, making an estimated 30% of extracted cardboard/plastic blend, not recyclable [12]. The momentum for the plastics food trays had started and the price of those single-use plastic trays have decreased and have become really accessible to every business even in smaller quantity for the takeaway food service. Still today, a vast majority of restaurants that provide a takeaway service are using single-use plastic trays.

With the growing awareness of the population and the pressure of consumers in recent years, directives are being established by the European Commission to limit the single-use plastics [13]. The idea is to impose stricter rules for the types of products and packaging that are among the ten products that are most frequently polluting European beaches. By 2021, single-use plastic plates, cutlery, balloon rods, and cotton swabs will be banned. By 2030, all plastics packaging placed on the EU market shall be either reusable or recyclable in a cost-effective manner and more than half of plastic waste generated in Europe shall be recycled. These new directives show the willingness of the authorities to separate from single-use plastics but the changes are slow and can be accelerated by each country.

3 Impact Gap Canvas: Solution mapping

3.1 Solution landscape

The concept of the new economy for plastic developed by Ellen MacArthur Foundation together with a wide advisory panel and numerous participating companies set the outlines of what changes are required worldwide so that the plastic never becomes a waste. The goal of their work is to identify ways for ending plastic packaging pollution while ensuring positive economic, environmental, and societal changes. The overall outline of a circular economy applied for plastic can be seen in Figure 4.

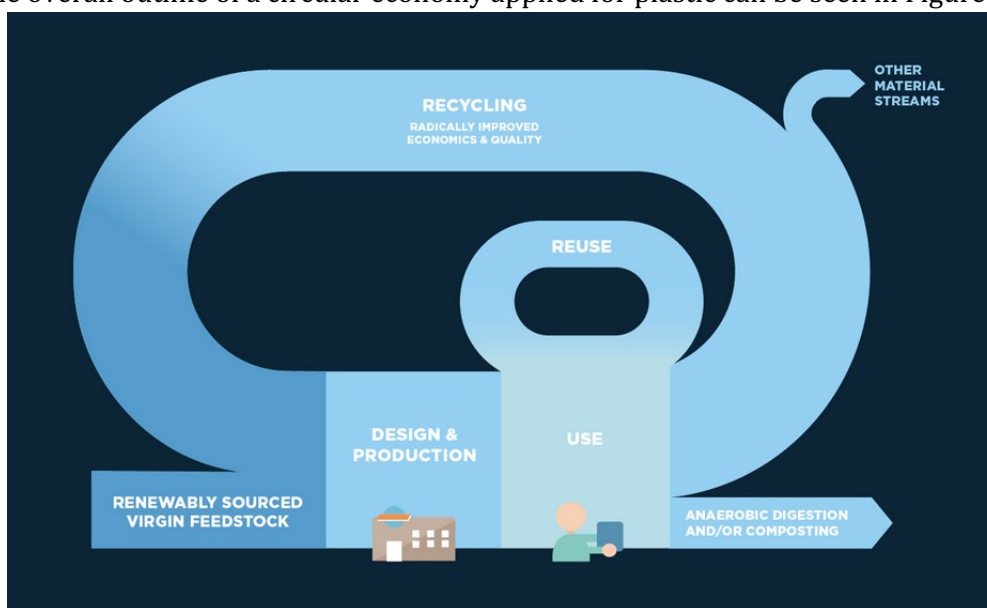


Figure 4: A circular economy for plastic [9]

Each key area represented in this graph can be a target for improvement, getting towards plastic circularity and thus significantly reduce plastic waste. This circularity is claimed to be achievable if following several key principles [9]. First, the elimination of plastic where not required, second, use a reuse model where relevant, third, ensuring that all plastics are reusable, recyclable, or compostable. Then, those plastics actually have to be reused, recycled, or composted in practice while making sure that the use of plastic is decoupled from finite sources. Finally, all plastic packaging have to be free of hazardous chemicals, for the security of people involved. The Lansink's ladder [14], represented in the Figure 5, is a way to categorise and prioritise the solutions recommended for waste treatment, according to their environmental impacts, often used when looking at waste reduction. The classification goes as follow, starting from the highest priority:

At the top of the pyramid is waste reduction. The best waste is undoubtedly the waste that is not produced. Even if their respective environmental impacts depend on many factors and need to be looked at with caution, a solution that involves reusing the plastic produced is often preferred than one involving recycling of the material. But of course, those two are still to consider first when applicable versus the transformation into energy, the incineration, or disposing of the waste into landfills.



Figure 5: Lansink's Ladder [14]

Translating this ladder along with some of the key outcomes from the work on the new economy for plastic to takeaway packaging and putting them through the filter of our problematic allows understanding what the landscape of solutions could look like. In essence, they are summarised by the first three rungs of the ladder, which means:

1. Do not give disposable packaging unless it is really required, for example when reusable options are easy to find.
2. Making sure that, as much as possible, the plastic that is required is optimised to be or reusable, recyclable, or/and compostable.
3. Finally, finding a way to ensure those well thought containers circulate within the chain so that all the plastic items used are kept in the economy and, most importantly, out of the environment.

Reuse system may not be mainstream at the moment when single-use packaging is still preferred. Their reusable alternative, depending on the scheme of application, can also be beneficial for the business itself. Reuse systems can indeed lead to reduced costs where single-use packaging can in the end be more expensive. It can also lead to improved logistics if the design is shared between brands or outlets, give a better customer experience using smart and high-value packaging, and improved brand loyalty through returning costumer of deposit and reward systems [9].

Focusing more on recycling now. On a European scale, an estimated 29% of collected plastic is recycled [15]. Recycle means that it will be reused but does not mean that a fully closed loop exists. The recycled plastic will be reused for the same purpose. Worldwide, the estimations are around 2% of recycled packaging that make their way back to be part of new packaging. Other types of recycling also exist, such as open-loop recycling where recycled plastic pellet find their way into another product category. Alternatively, in some instances, the plastic can be turned back into the raw materials premanufacture through chemical recycling techniques. Finding a way to improve recycling rates will go through better at home and on the go sorting but also through an improvement in the facilities and the technologies available. There is for example hardly any takeaway box (e.g. a burger box) in expanded polystyrene that can actually be recycled. So even if the sorting and the collections are as pure as they can go, 30% of all plastics would still not be recycled [9]. If the quantity of collected material is not available in sufficient quantity, the recycling chain will not appear. One needs to start and act as an incentive to the other. In addition, proper sorting can be an issue for multi-material packaging, as well as cleaning when the packaging is contaminated with strong glues from labels or inks from printing. Improvement of recycling thus also comes thanks to eco-design and eco-conception [16].

Alternatively, we can consider that what is not recycled could be replaced with biodegradable materials, which is an additional route for eco-conception. Bioplastics and biodegradable are also making their way into people's minds. But the distinction needs to be clear between what they

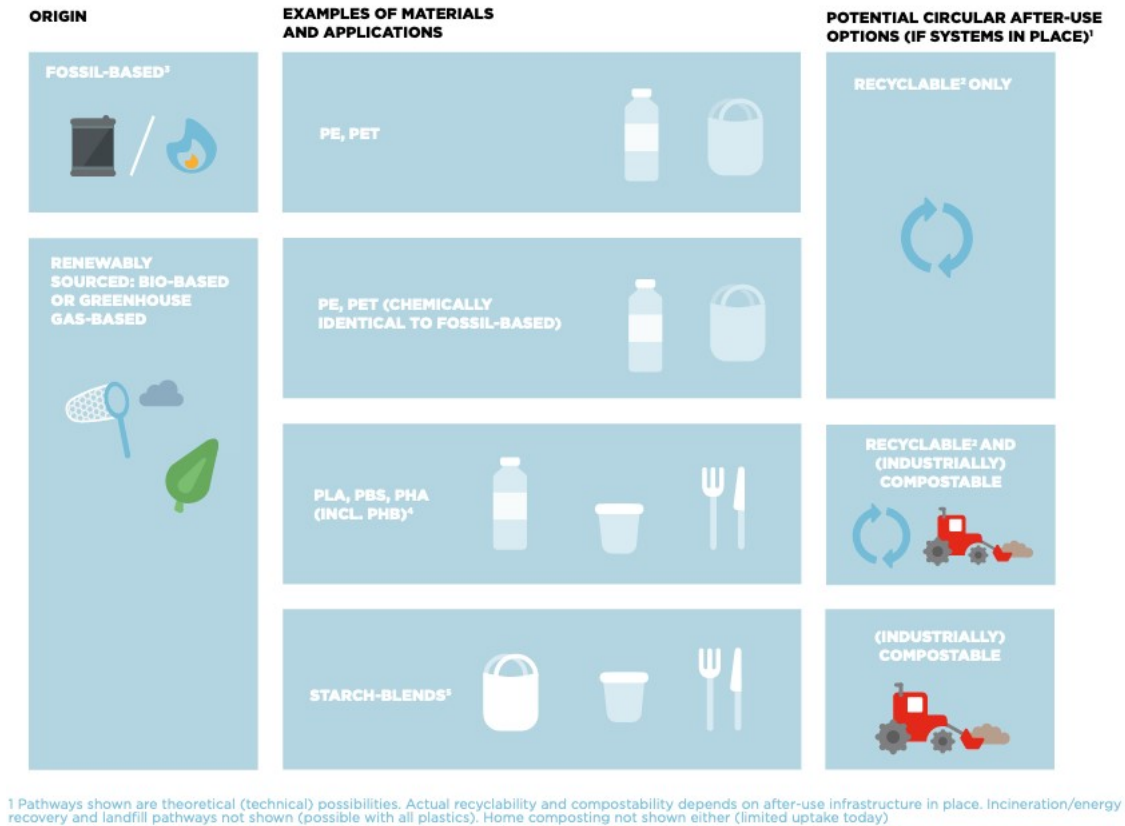


Figure 6: Bioplastics, origins and end of life [9]

mean as well as why and when they could be beneficial, as presented in Figure 6. Bioplastics are made from bio-based sources such as cellulose, lactic acid, starch derivatives, or as a co-product of bioethanol production[9]. The PHA (Polyhydroxyalcanoate) or PLA (Polylactic acid) are examples of bioplastics. The term biodegradable by itself is often misused as it only describes that a material can biodegrade into natural elements with the help of micro-organisms. The compostable term is often more appropriate as, outside of composting conditions, most of these plastics will remain unchanged in months or years. Some bioplastics are also compostables but not all of them. There is also the great importance of composting conditions since industrial conditions (6 months at 60C) are required for the wide majority of biodegradable plastics for their decomposition (90% by weight during the 6months treatment). If well treated, compostable packaging can be an important enabler to return more nutrients of packaged contents to the soil.

Finally, energy conversion, incineration, and landfilling are to be avoided as much as possible. Even if some energy can be recovered, only a fraction of the material's potential can be exploited and a part of the material or its residues end up as unexploitable wastes.

3.2 Model for change

There are several potential steps onto the Lansink's ladder where improvements are tried and tested to avoid disposable packaging waste. This section is presenting a non-exhaustive overview of identified alternatives that are applicable in Belgium. One of the ideas comes from public funding. For example, the SPW (Service Public de Wallonie) is searching and calling "Zero Waste" projects for HoReCa institutions or food trades to offer them subsidies which could in the end reduce the packaging waste [17]. This is here the top of the Lansink's ladder part: Reduce. Some municipalities are also more aware than others of the zero-waste way of life and are therefore offering additional subsidies[18].

An attractive project acting in the Reduce part of the scale is called ECOPOON. This initiative does not act directly on disposable packaging but rather on disposable plastic cutlery. Their objective is to suppress plastic waste by offering edible cutlery that can be adapted to the different types of food. That is to say that they must be strong enough not to break, but also having a taste that can adapt to the food (sweet and salty). Similar initiatives can be imagined for packaging.

The step where there are the most emerging solutions is the Reuse part of the ladder. A first idea is on a deposit system for reusability supported directly by the company or by a company network. This is the case for the Belgian well-known system of Jupiler, but also on a smaller scale for Billie Cup, which purpose is to avoid the amount of disposable cup waste by proposing a reusable cup called the 'Billie Cup' with a deposit that can be brought back to any participating location.

There are also centralized deposit systems supported by external organisations. Two recent startups have been created this year using this technique: 'L'Empoteuse' and 'Bring Back'. Since it is difficult for a small business to implement a full deposit system, these two projects are offering this type of business an alternative to disposable packaging with returnable glasses. They offer them the opportunity to avoid all logistical and cleaning constraints by collecting themselves glass jars or boxes and by using subcontractors for cleaning them.

Another alternative is to use a reusable lunch box at a restaurant, caterer service, canteen, or even grocery which is bought by the consumer. This is then its own and he has to clean up by itself. The 'Tiffin' company is offering this alternative in Belgium. This initiative is based on the consumer's willingness because restaurants have nothing to do. They just have to be a partner of the project. The great advantages for the consumer are then to avoid disposable packaging waste but also to obtain a price discount onto any partner restaurant.

The next category of solutions is based on the recycling process of packaging waste. For this purpose, the sorting centre of PMC SITEL (Intradel Group) has created a new and adapted PMC bag allowing to expand and diversify the plastic waste collection. This is done to improve the number of fractions that can actually make their way to recycling. This is a step to reduce the gap in recycling which is actually much less efficient compared to other materials. Once the collection of those new plastic categories will be well established, new or improved recycling facilities can arise. Quantities are still at the moment a limiting factor for going towards the profitability of those minority plastic fractions. It could finally allow incinerating less plastic waste than today. The whole process of recycling has to be improved years after years. Since the introduction of this new PMC waste collection bag, the consumer has to adapt and increase its sorting habits.

Also, another possibility of improvement comes from the packaging eco-conception. Indeed, a possible solution could be to use bioplastic, thus avoiding the source of the problem. This is therefore important to know the distinction between biobased and biodegradable plastic terms. Biobased means that it comes from biological, often renewable resources while biodegradable plastic has the potential

to be naturally degradable by living organisms. Actually, if the recycling problem is wanted to be avoided by the producer, trying to achieve similar performances with biobased materials should cost from 20 to 45cts per unit, which is much more expensive than the 14cts per unit of the classic plastic disposable packaging. This new specialized source of material for making packaging is actually studied by, for example, the technical and scientific service centre CELABOR which collaborates with Technifutur and Sirris industries.

In the ENERGY part of Lansink's ladder, some solutions are investigated. The objective is to generate energy from waste materials, so none of this waste is not to be left aside. After being sorted in different fractions by the SITEL centre, most of them can be bought by recycling companies. The rest is sent to Uv'elia for incineration, in order to be converted into energy. The rest of the waste from Liège province that isn't biovalorised is sent to Uv'elia which uses it to produce electricity by incineration. Polypropylene, one of the most used plastic for takeaway packaging, is recycled by the QCPolymers company. Moreover, it allows them to avoid the end of life of plastic waste due to its incineration since it is not valorised otherwise.

Project solutions presented in this section are the ones existing in Belgium, but many similar projects are existing in many other countries such as GoBox, Reconcil, ReBowl, Vytal, Dabba Consigne, Chrysalis.

3.3 Future impact scope and scenario

A recent study conducted on 4000 french aged between 18 and 75 years old showed that 9 out of 10 french expect food brands to reduce the use of plastic packaging and 5 out of 10 are in favor of the deposit [19]. With the increasing pressures of the consumers and the multiplication of new directives, the movement for stepping away from plastics will take place sooner or later.

The different actors of the problematic move at different paces. Some big businesses, governments and other organisations are already committed to this cause. The Ellen MacArthur foundation in collaboration with the UN Environment managed to gather nearly 400 signatories to a common vision and targets to address plastics waste at its source. Signatories includes nearly 200 business actors of the packaging value chain. Those companies are jointly responsible for more than 20 % of all plastic packaging used globally.

Figure 7 gives an overview of the biggest companies involved in the plastic packaging chain and which of them have signed the deal or are on the verge to do so.

#	FMCG ²	#	Plastic Packaging ³	#	Retail ⁴
1	Nestlé	1	Reynolds ⁶	1	WalMart Inc.
2	Procter & Gamble	2	Amcor	2	Costco
3	PepsiCo	3	Berry Global	3	The Kroger Co.
4	Unilever	4	Sealed Air Corporation	4	Schwarz Group
5	AB Inbev	5	RPC Group ⁷	5	Walgreens Boots Alliance
6	JBS	6	Bemis ⁸	6	Amazon.com, Inc
7	Tyson Foods	7	ALPLA Group	7	Home Depot, Inc
8	The Coca-Cola Company	8	Interplast	8	Aldi
9	L'Oréal	9	Aptargroup Inc.	9	Carrefour
10	Mars, Incorporated ⁵	10	Silgan	10	CVS Health
				11	Tesco PLC
				12	Aeon Co., Ltd
				13	Target
				14	Ahold Delhaize
				15	Lowe's Companies, Inc.

☒ Has signed the Global Commitment
 ☐ Has not signed the Global Commitment
 ☐ Merging or has merged with other top ten players

Figure 7: Participation of the largest (by revenue) fast-moving consumer goods (FMCG) firms, plastic packaging producers, and retail companies in the Global Commitment. [9]

Six of the top 10 fast-moving consumer goods companies, 7 of the top 10 plastic packaging producers and 5 of the top 15 retail companies have committed to the Global Commitment. This Global Commitment sets goals to eliminate the unnecessary plastic packaging from their product, use a reuse model where it is relevant, turn all of their plastics packaging to 100 % reusable, recyclable or compostable by 2025.

The European Commission introduced the Product Environment Footprint (PEF) that will contribute to inform the consumer of the environmental impact of the product he consumes. The PEF is a score attributed to a product that assess its entire environmental performance at every stage of the supply chain, throughout its life cycle, to take into accounts all the impacts of their products on the environment.

According to a poll on green products published by the European Commission [20], 48% of European consumers are disoriented by the flow of environmental information they receive. While they tend to prefer goods that are healthy for them and for the planet, they no longer trust brand communication, tired of green washing. Indeed, there are more than 400 environmental labels on products and services around the world, with sometimes very low transparency on what they actually mean.

The idea behind the PEF label is to uniform those labels and to judge a company true green credentials. In this context, we had the opportunity to interview Michael Ooms from Yukan. His startup provides digital tools to manufacturers in order to evaluate and score the environmental performance following the PEF method of their products. The ambition of the startup is to generalized the PEF label to all the products in Europe so that the consumer can become aware and choose accordingly their product depending on their environmental impact.

Those two organizations could strongly impact our problematic. Indeed, if the plastic packaging industry produces less impacting products for the takeaway food service and, if the different caterers have more vision on the PEF of the different plastic packaging solutions, it could help them to orientate themselves towards the best ecological and economical solution for their businesses.

Looking more precisely on the plastic trays problematic in the takeaway food, solutions have been developed nationally by countries like Germany. Being aware of the solutions that are becoming well established in other European countries can help outline what are approaches that are the most likely to be adopted. ReBowl is a similar system to the deposit bottles in the beverage market. For a deposit of 5e, the customer get their take-away food in the ReBowl container, when they return it they get back the 5e deposit and the container is washed by the caterer. The other big system is Vytal, the concept is similar where the customer get their take-away food in a reusable container to the difference that in the Vytal system, there is no deposit needed but everything is recorded in the application and if the customer does not return the container before 14 days, it will be charge of a fee of 10e. Those two systems are being rolled out nationwide in Germany and the system is becoming more and more widespread amongst caterers. Those 2 systems are already covering about 800 distribution points in Germany, showing a real potential for this approach.

4 Impact Gaps Canvas: Impact gaps

4.1 Unaddressed obstacles

Now that the different solutions to reduce the ecological impact of plastic packaging have been exposed, let's look at the different disadvantages of those solutions following the Lansink's ladder approach.

The first point of the Lansink's ladder is the prevention step and as said before: ' There is no better waste than the one that is not produced '. There is no clearly identified drawback on this point and let's move to the second one.

The second step of the Lansink's ladder is the product reuse point. This step relates to containers that are washed and reuse. If we first look deeper into the reuse model, there are four models that can be exploited in a business to customer relation [9]. A reuse of a packaging can be done through a refill at home or on the go. Or it can also be done using a return system, from home or even on the go. Then, two categories have to be distinguished on those solutions, whether it proposes a centralised washing center or if they ask the individuals to wash themselves the containers. This is a useful frame for thinking about solutions that could be otherwise missed if the thinking are a priori too channelled towards one of the options. When applied to takeaway packaging, not all models can be applied, but at least they will not be missed for lack of consideration.

For the centralised washing solution to be ecologically and economically viable, it is a question of scaling. Thanks to the interview of M. Finck, the supply director of the Benelux for AB Inbev, we were able to better understand the AB Inbev returnable bottle system.

Firstly, the cost of a one way glass beer bottle is about 10 cents when the brewery pays its reusable glass beer bottle 12 cents each. So the investment at the beginning is not the same. The cost for the washing is approximately of 2 cents for one bottle. Taken that into account and adding the cost for the transportation, logistic and that 10-15% of the bottles are lost, the company have calculated that for this system to be economically viable, the bottles needs to be reused at least 7 times. Looking at the environmental impact, an internal study has concluded that the returnable bottle produces less CO2 after only the second reuse when compared to the one way glass bottle. Such results are possible thanks to the big volumes of the company. Indeed looking at the Jupiler Brewery in Jupille, it has 3 bottle washers machines that can make up to 100.000 bottles per hour. But the price of a bottle washer is quite consequent reaching 4 million euros. In addition to the investment due to the containers and the washers, the brewer has also to take into account the transportation. They have estimated that if the

bottle travels more than 250 km between the production center to the consumption place, the system loses its economical benefits.

Looking at those numbers, it is easily understandable that such a system for reusable plastic trays with centralised washing centers have to be carefully studied in order to be profitable and in order to make sense ecologically. The washing price, the transportation cost and the volume are the three biggest factor that influences the viability of this system. For smaller systems such as 'Bring Back' or 'L'Empoteuse', the price to wash their reusable containers is estimated to 25-35 cents/unit.

In the case of numerous ecological, zero waste supermarkets or in the Vytal/ ReBowl system, the washing is done either by the customer or by the caterer. This is the best system that can be implemented since everything is done locally and the transport is eliminated. Unfortunately, many of the caterers does not have the time, the energy, the equipment or human resources to wash the containers themselves. On the client side, a convinced part of the population already brings their own container in order to reduce as much as possible their impacts but it is time and energy demanding and the wide majority of the population is not yet ready for it.

For any reuse model, it is essential to see the ecological impact using a life cycle analysis approach. An example could be the previously mentioned PEF indicator. When reusing, it is essential compare the difference in weight and volume of the containers, the number of reuse, the distance travelled between two use and the transportation medium used. A glass reusable glass bottle is only more beneficial than a PET one after a minimum of 13 reuses [21].

At the third step of the Lansink's ladder is the material recycling. The improvement of the material used is also included in this section. Thanks to the interview of Mr. Marchal, director of SITEL who is responsible for the sorting of the PMC bag in Liège, we had the opportunity to learn more about the recycling process in Liège. Even though it is true that the content of the blue PMC bag has been extended to accept the single use plastic trays since December 2019, we are still in a transition period. The sorting of the new plastics (polypropylene or PP) is not efficient yet. Indeed, the new sorting centers are projected to be finished by 2022 and so far only a small part of this new content is actually sorted. Most of it ends up incinerated. In addition to those new materials, technical limitation of the processing equipment is also an issue. The black plastic trays for example are not detected by the sensor and end up in the waste fraction for incineration. It is as well very difficult to trace back where the plastic came from and may contain hard to detect additives that can be undesired or forbidden in other applications. There is a lack of uniformity but also, not enough recycled plastic produced to satisfy the demand [22].

Furthermore, one must keep a critical approach to the numbers given when looking at the figures of the recycling rate of plastics. Figure 8 shows where this recycling rate is calculated currently and how the European commission will legislate by the end of 2020 for this rate to be calculated later in the recycling chain.

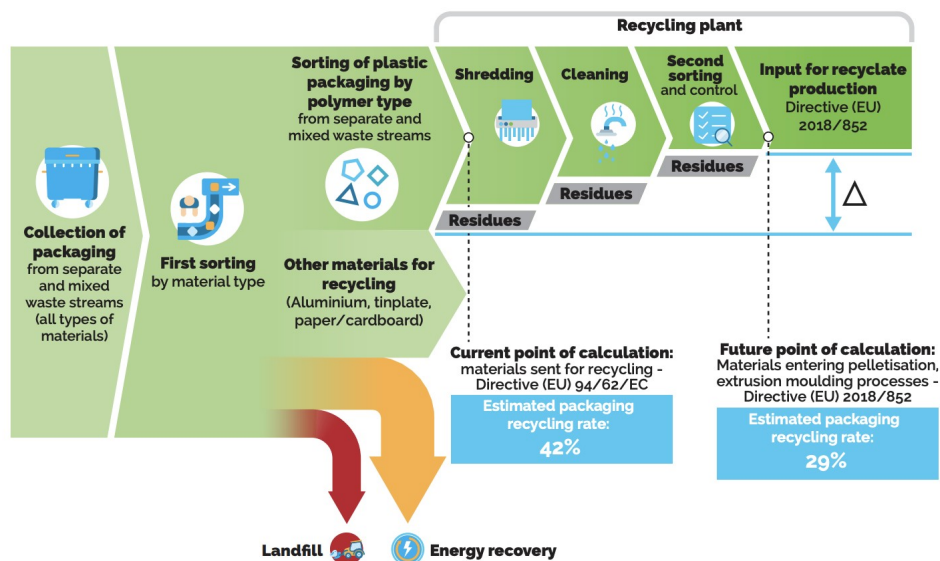


Figure 8: Calculation of the plastic recycling rate [15]

Indeed, a change of calculation methodology lead to lower recycling rates since an estimated 30% of the weight of the plastic that enters the recycling segment is lost due to residues in the different part of the recycling process. In addition, as a side effect of the COVID-19 pandemic, the price of the oil has dropped to low records and the recycled plastic has then become even more expensive than new plastic than it already was.

Concerning the bioplastics and biodegradable plastics, a lot of caution needs to be taken into account when flirting with those concepts and again, if the approach is not holistic, there might well be more negatives than positives related to their impacts. They can be part of the solution as long as they are collected and treated appropriately. So far in Liege, no such collect is implemented and those plastics end up burned to produce energy losing all their interest as biodegradable.

The two last steps of the Lansink's scale are the incineration with creation of energy. All the residues of the selectively collected and the raw household waste in Liege are incinerated in Uv'elia. They are talking about 'green energy' when designating the type of electricity obtained with the waste burned. It is sure that it is better than simply incinerate them or bury them as in the Landfilling step of the Lansink's ladder but it is a shortcut to call it 'green' knowing that those two last solutions have the most impact on the environment.

4.2 Impact opportunities

The most important is to know customers' desires and needs. Indeed, all alternatives, solutions and improvements can operate only if the customer wants to use them and adapt its way of life with those. Fortunately, trends are changing because more and more people are aware of the plastic waste problem. As an example, "Zero Waste" trends earn more and more interest with time. Many other businesses are showing a willingness to adapt in order to be more in line with their customer desires. However, the majority of consumers are not pro-active. Then, they are not able to modify themselves their way of life. Furthermore, this is extremely difficult for small companies to take time for purposes of setting up alternatives on their own because they are all very busy with their everyday activities. This is for those reasons that finding alternatives is actually a great opportunity. Only few, recently developed, solutions exist which are not covering the entirety of the plastic waste problem.

The biggest opportunity for impact is then to offer alternatives which do not complicate the customer's habits. Indeed, if it is not more complicated or even ideally simplifying his habits, the customer will be able to adopt it quickly and easily. Consequently, solutions from business to business will involve a greater impact onto consumers. As a consequence, the value proposition has to be attractive also for the trade because it has to be accepted. It cannot disturb the main functions of the institution. This is why it is important to avoid constraints for them as far as possible. It could be logistical, cleaning or even compatibility constraints, and they have to be properly taken in charge by the alternative project.

Another attractive opportunity is to have a lot of partnerships. Indeed, the more partners, better the label quality. This represents a great advantage for the customer, but it is also a major asset while negotiating with potential new trades.

Furthermore, the disposable plastic taxes actually exist only for plastic bottles. However, the plastic waste is a huge problem, and of raising interest for European institutions. Therefore, it is only a matter of time before taxes on plastic packaging increase sharply, as already happening in Spain, Italy and in the UK. It will be a turnover in the plastic industry, then the interest on all existing alternatives will grow up strongly [23].

Thanks to the identification of those opportunities, it is now possible to take those new learning, exploit them, and suggest alternatives capable of having a real impact.

5 Ideation Sprint

Thanks to the knowledge obtained during the course of the study, through various interviews and literature reviews, it is easier to define what the value proposition of a potential solution could look like. This solution would have to take into account the pain and the gain that have to be targeted for the food on the go provider but as well for his customers. His job to be done is primarily to sell his food to his client while making sure he has a mean to transport his food to his final destination. Yet, there is a will to decrease the amount of plastic waste they are generating, as well as the overall negative impact on the planet of this transportation medium.

5.1 Value proposition

The value proposition ideally needs to deliver at least 4, if not more, elements of values based on Bain's Element of Value pyramid to be the most likely to succeed. Bain Company actually developed two models to classify the possible Element of Value, one for B2B and another one for B2C [24]. Identifying multiple Element of Value across the B2B pyramids seemed the most relevant route to go. Suggested Element of Value that most need to be taken into account are presented below:

- **Meeting expectation:** especially his clients expectations, as the value proposition has to integrate health and functional elements (be safe for food contact, do not present any risk for health, keep the food at appropriate temperature during transportation time, without content losses)
- **Acceptable price:** given the very cheap cost of current plastic packaging used, so the price has to be competitive
- **Configurability:** being able to adapt to the different specificities of the premises and of food to be transported

- **Integration:** the value proposition needs to find its place in the current system with minimal change for the professional and the final client
- **Reach:** to address other customer segment (such as eco-conscious, zero waste seekers, plastic avoiders)
- **Social responsibility**

As a result, a suggested value proposition that could help catering professionals to get their job done while maximising the gains and avoiding the pains can be enunciated as:

We help SMEs of the catering industry who want to ensure that their clients can takeaway the food they sell while reducing their environmental impact and plastic waste generation. This needs to be done by satisfying their customer needs and expectations and prevent negative impact on their cost, workload and storage capabilities.

5.2 Ideation

This value proposition combined with the design sprint method of the Crazy 8's, to trigger idea generation, was used to find potential solutions that would fulfill the requirements. As one of the underlying goals is also to diverge in the ideas found to keep a broad approach while still being in target, not all ideas generated have the same level of credibility, feasibility, viability, or desirability. It is only as a second stage, that one of the suggested solutions can be chosen as demonstrating a higher interest. Once pooled and put into categories, the solutions proposed were:

- **REDUCE**
 - Food delivery service directly on customers' plate
 - Edible food container
 - Only having an eating in option
 - Only serve large portions of a single meal to optimise packaging shape and reduce the weight required
- **REUSE**
 - Deposit system with drop off at the catering facility and externalised washing and packaging logistic
 - Deposit system with drop off at the catering facility and washed within the facilities
 - No-cash deposit system, where charge is made only in case of failure to return/use the container after a given time
 - Deposit system where part of the packaging is single use to allow customisation/marketing
 - Deposit system combined with outdoor and/or indoor automated collection points
 - Sell reusable container that belong to the final customer and offer discount on use in partner institutions

- Sell reusable container that acts as a loyalty card with shared benefits or rewards across partner institutions
- Food delivery where the delivery person share the meal with the customer and take back the packaging
- Food delivery combined with container pick-up service
- Geo-localised packaging with shared use across users

- **RECYCLE**

- Deposit system for recycling (not for reuse)
- Easily biodegradable and affordable bio-plastic
- Focus on using only well recycled plastics
- Focus on using the same food packaging catalogue, using the same material, for all the catering industry with a dedicated recycling chain
- Develop an easy to recycle packaging, making it as the only choice to use within the catering industry of a given city

5.3 Pretotype

For the choice to go towards one of those solutions, a complete analysis should be done on each of them. For convenience, we decided to work deeper on one version of the solution that captured our interest for the rest of the Idea Sprint and be able to finish this exercise with a pretotype. The suggested solution is using a takeaway packaging under a no-cash deposit scheme, where the end customer would only pay if the packaging is not used or returned in a predefined given time. Several hypothesis would have to be validated on the field to validate or invalidate the factual credibility of the solution; and this is all the interest of the pretotype. The first key hypothesis to be tested is the one to which the solution is the most sensitive. The main blockers identified are: 'Is the end customer willing to use a takeaway packaging, he might end up paying for?' and, 'Is the food catering professional willing to use an externally chosen reusable takeaway container to serve his clients and to store returns as long as it does not generate other extra work?' Pretotyping the second can actually be done through a simple question, would you accept me to be the deposit system behind the counter - I give you the packaging, take the deposit, and give the money back when relevant. There is no real need for pretotyping as the answer to this question already validate the hypothesis. The higher priority hypothesis to test is more the first one. The following pretotype could be implemented. Using more sturdy packaging, it is possible to work with volunteer establishments to put a deposit system on the packaging at different values; 1, 3, 5e for example, and see if the customer is willing to give temporarily this extra money, while doing something beneficial for the environment.

Overall, this is only one option for a solution, and the hypothesis to test is only the most important one at this stage but many more are to come. Number of trials, learnings, iterations and changes might be required to truly get to a tangible and sustainable pathway.

CONCLUSION

Plastic waste due to food packaging in the catering industry in Belgium is a real problematic of concern, essentially through its environmental impact. The well-adopted solution of single-use plastic is cheap, convenient, functional, and well accepted by consumers. Using plastic is not always something bad, exploring life cycle analysis and lack of recycling opportunities for alternative materials can be in some cases a good argument to keep using it. The issue is not the plastic per se, but more the way the habits of plastic and catering industries are constructed. At comparable economic values, there is a resilience to change any deeply rooted habits.

Yet, there is raising awareness of the environmental impact of our consumption habits, especially in the younger generation. The growing willingness for change can help economically and environmentally sustainable solutions to be implemented and accepted. More and more solutions are emerging within cities, communities, and sometimes countries. The lack of cohesion between all initiatives seems an obstacle to a quick adoption but still proves that change is on the way. Consumers are more conscious of their waste. However, even if sorting our waste remains a valuable gesture, going towards a world of all recycling is not a solution on its own. Any attempt to reduce this waste stream has to maintain a focus on the catering professionals, in such a way that it will not be detrimental to their business, and still be easily accepted by their clients. A context of a circular economy of plastic seems a good route to go and will need an implication of all members of the chain.

The overall mantra often heard during the study: 'the best waste is the one that is not produced', is the key factor. Solutions that prone the reuse of the containers stands very high in the most impactful opportunities as long as they are actually sufficiently reused. Working towards an end of plastic landfilling and incineration is a second stream of highly valuable solutions. Promoting recyclables and biodegradable plastics is also taking an important part. But more importantly, those latest have actually to be recycled/composted while maintaining streams in a closed-loop as much as possible. None of those eventualities clearly emerges as the preferred solution. The findings of this study demonstrate that a combination of approaches in a strategically designed dynamic and over the widest possible territory is what stands out as the quickest road to success.

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Appendix A: Persons interviewed

- Mrs. Angélique Léonard, Professor at University of Liège, interviewed: 22/10/2020
- Mr. Laurent Marchal, Director of SITEL 'Sorting center of PMC', interviewed: 20/10/2020
- Mr. Renaud De Bruyn, 'ecoconso asbl - Waste and food expert, interviewed: 14/10/2020
- Mr. Laurent Halmes, Entrepreneur at Bring Back, interviewed: 21/10/2020
- Mr. Michael Ooms, Co-Founder at Yukan, interviewed: 16/10/2020
- Mrs. Marie Jemine, Founder of L'Empoteuse, interviewed: 14/10/2020
- Mr. Cyril Ernst, Co-Founder of Ecopoon, interviewed: 15/10/2020
- Cap Sud, Caterer in Liège, interviewed: 08/10/2020
- Mr. Phillipe Le Roux, Butcher Caterer, interviewed: 02/10/2020
- Mr. Wuidard, Caterer in Herve, interviewed: 06/10/2020
- Phong Huy, Chinese Caterer in Liege, interviewed: 02/10/2020
- Mr. Marc Schmitz, Butcher Caterer in Liege, interviewed: 04/10/2020
- Chez Dam, Caterer in Liege, interviewed: 05/10/2020
- Mr. Theunissen, Butcher Caterer in Jupille, interviewed: 02/10/2020