Transcript - Waste Management (Training D4CG Module 1)

Date of video: May 10th 2022

Goal of the Session

This first module will cover Waste Management and so an overview of the circular economy, realities of waste management infrastructures and an introduction to the EPR schemes. it's crucial to understand the waste management infrastructure before we make any recommendations on how we can design our packaging. Three main topics:

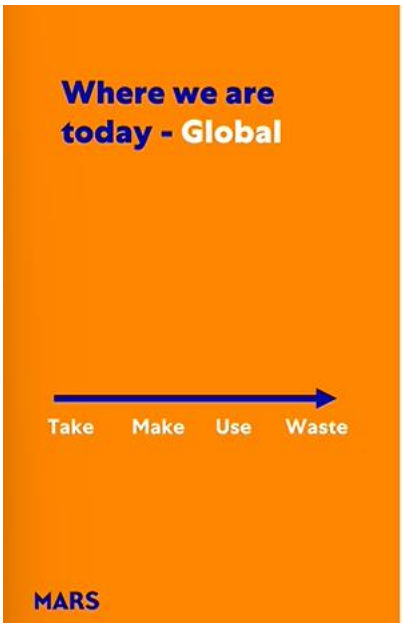
1) Circular economy and how it relates to Mars
2) The different types of waste management infrastructure
3) Financing and the EPR schemes

Circular Economy

Linear Model

The circular economy is in contrast with the linear economy that we are currently experiencing. For now (2022) our economy works in a way that: we take resources from the planet, we make goods, we use them and then we just discharge them, ending up as a waste. By continuing in this linear model, we are creating a lot of waste meaning pollution as waste is not always properly managed. We are pumping a lot of resources from our planet but as resources are limited and we are continuing to extract those resources even if the world's population is growing as well as the middle class, then there is a real challenge on continuing on this linear economy where we just take and we waste.

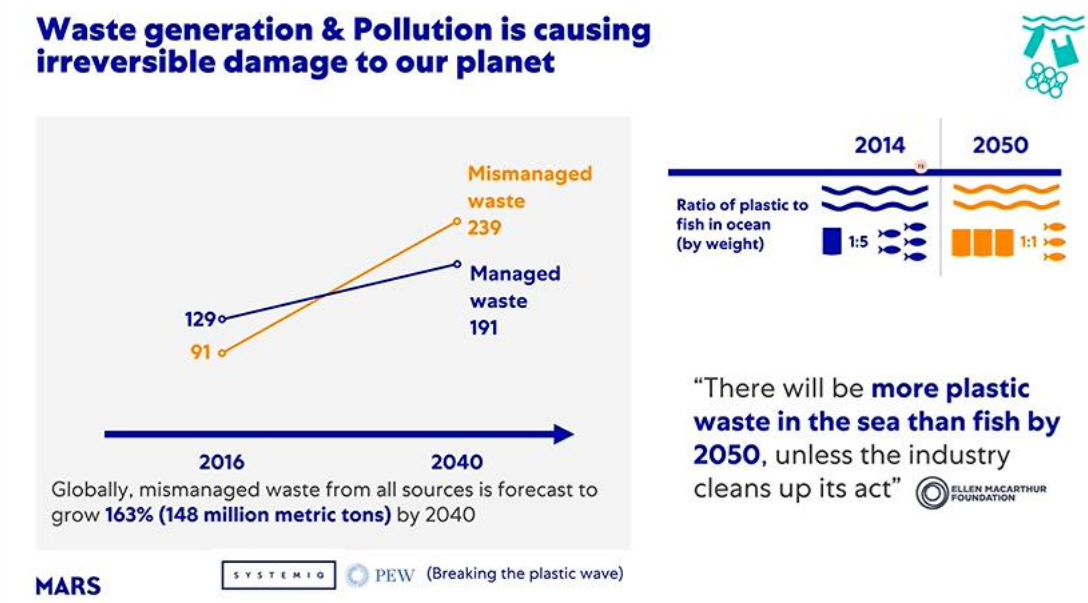
Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

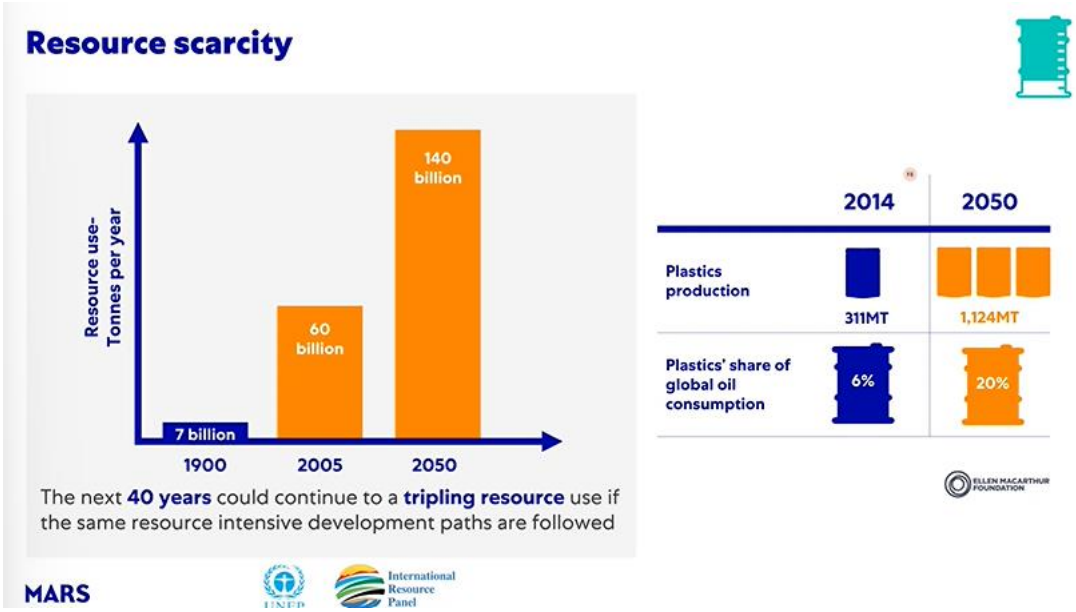


Resource Scarcity

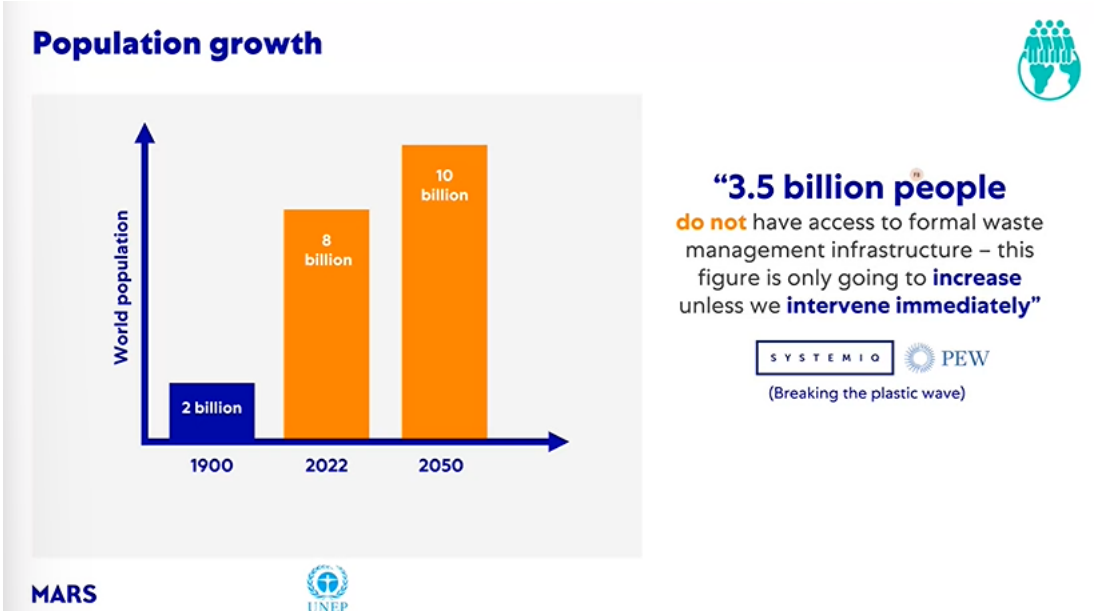
Unfortunately, there is a lot of waste that is not properly managed and that might have a chance to end up in the environment. This is the case in Asia Pacific or in Africa where the waste management infrastructure it is not in place and unfortunately, we are expecting, if we do not take action, mismanaged waste to double by 2040, according to reports done by systemic view. And the Ellen MacArthur Foundation, a think tank that it's working on the circular economy, have illustrated this quite nicely by saying that if we do nothing by 2050, we might end up having more plastic waste in the oceans than fish. Resource scarsity is becoming the main challenge, in 1900 the whole planet was using around 7 billion tons of resources, in 2005 this was 60 billion, 10 times more only in 100 years, expecting this amount to even double by 2050. And if we focus on plastics, the plastic packaging is going to grow, in 2022 around 300, 350 million tons of plastic is used, expected to be more than 1 billion tonnes by 2050. And because plastic is using a lot of oil, the share of plastic compared to oil will also triple from today to 2050. Furthermore the population is growing, expecting 10 billion by 2050, meaning that more people are consuming, more people are generating waste and more resources are needed. In addiction, the average quality of life is increasing, which means a higher consumption and more use of goods. So in this context we really have a big challenge on what we can do.

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022



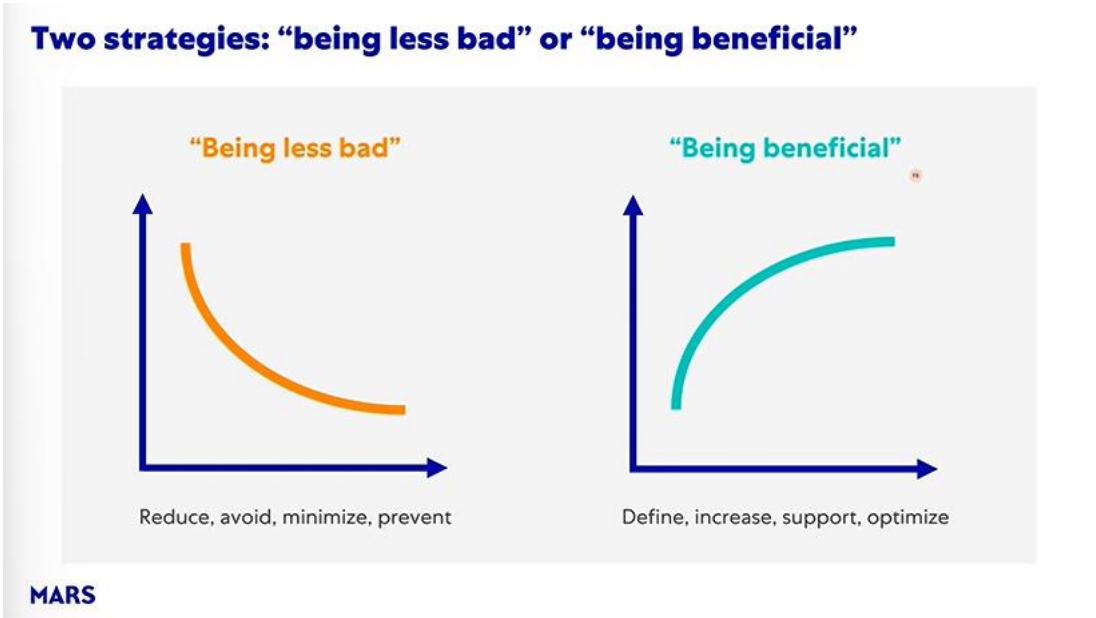


Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022



Strategies to overcome the Resource Scarcity challenge

Regarding the context of packaging, one of the challenges is how to switch from linear economy that is the one present in 2022 into something else. The two main strategies to deal with this transitional process are: one can be identified as being "less bad" so reducing resources use, reducing the waste generated, and so the environmental impact as CO2 emissions. However this is not a solution but only postponing the problem. But from a business perspective this strategy is not optimal, as the objective of a company is to increase the revenue. So having as a target the resources reduction, it means that, exaggerating, but companies will have to sell less. So the resources reduction strategy is in a contradiction with companies' revenue objective. The second strategy can be identified as "being beneficial", setting a positive agenda. So instead of focusing on resources reduction, the priority is to identify the right thing to do to solve the linear economy's problem and defining a North Star to achieve and based on this North Star, set actions to transform linear economy to circular economy.

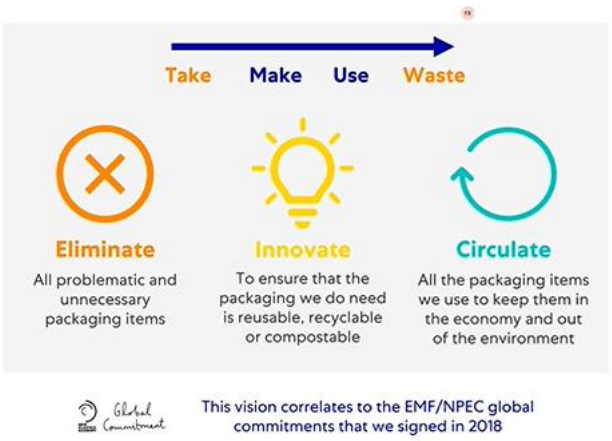


Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

Defining Circular Economy

Circular economy is about keeping the resources in the environment and out of nature. The main idea is to eliminate the concept of waste, present in the linear economy, and replace it with the idea of having the materials of the resources circulating in the system. Mars, has been inspired by the Ellen Macarthur foundation and the global commitments signed in 2019. The global commitments are based on three pillars.

1) Elimination of the packaging not needed in our portfolio.
2) Innovation to ensure that the needed packaging is reusable, recyclable or compostable, and so taken by the circular systems.
3) Keep the packaging items in the economy and out of the environment.



Mars Packaging Portfolio

The following image shows Mars packaging portfolio, unfortunately in a linear Economy mode. In fact Mars packaging when becoming a waste, is slightly recycled, around 10% (referring to 2022) is either recycled or reused. Most of the "Managed" packaging goes to incineration and landfill. And in some cases it's also ending up as a "mismanaged" waste, meaning that it will end up in the environment because the waste is not properly managed, so causing pollution. When we look at Mars plastic packaging portfolio we use less than 1% of recycled plastic and more than 99% of virgin material. So Mars is in linear economy because using exclusively virgin material and a lot of packaging waste, which is not recycled (the best case scenario, it's, it's 10%).

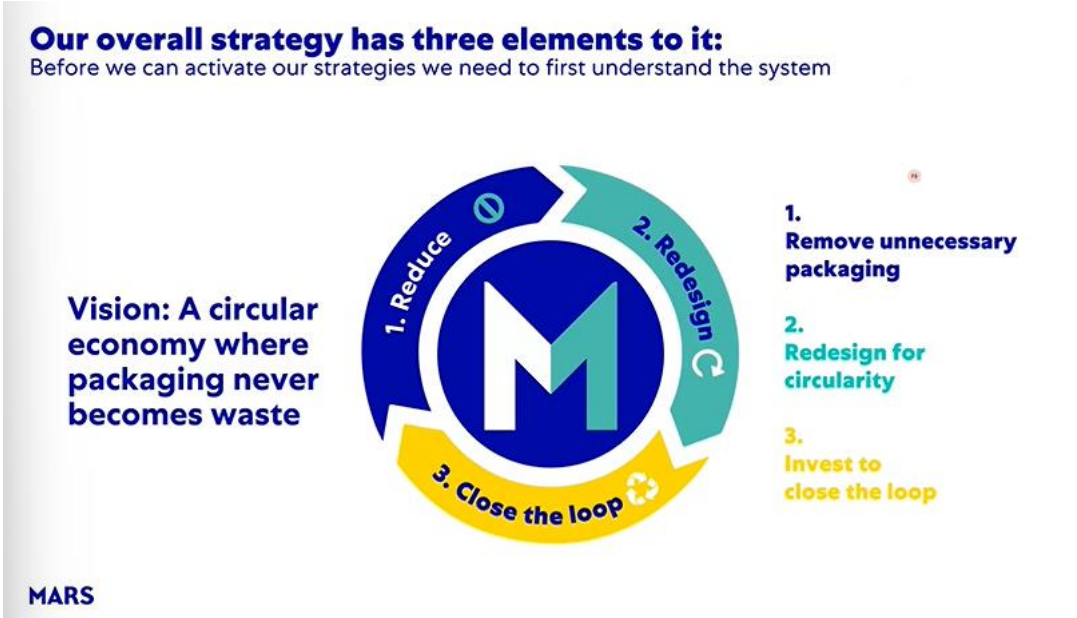
Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

Mars Circular Economy Strategy

In 2019 Mars developed a strategy inspired by the circular economy, with the vision that packaging will never become waste. And this strategy is based in three pillars.

1) Reduction of the packaging not needed, either lightweighting or switching, for example, from single use to reusable packaging
2) Redesign the packaging that we do need in our portfolio
3) Closing the loop by making investments to finance infrastructures and buying recycled materials

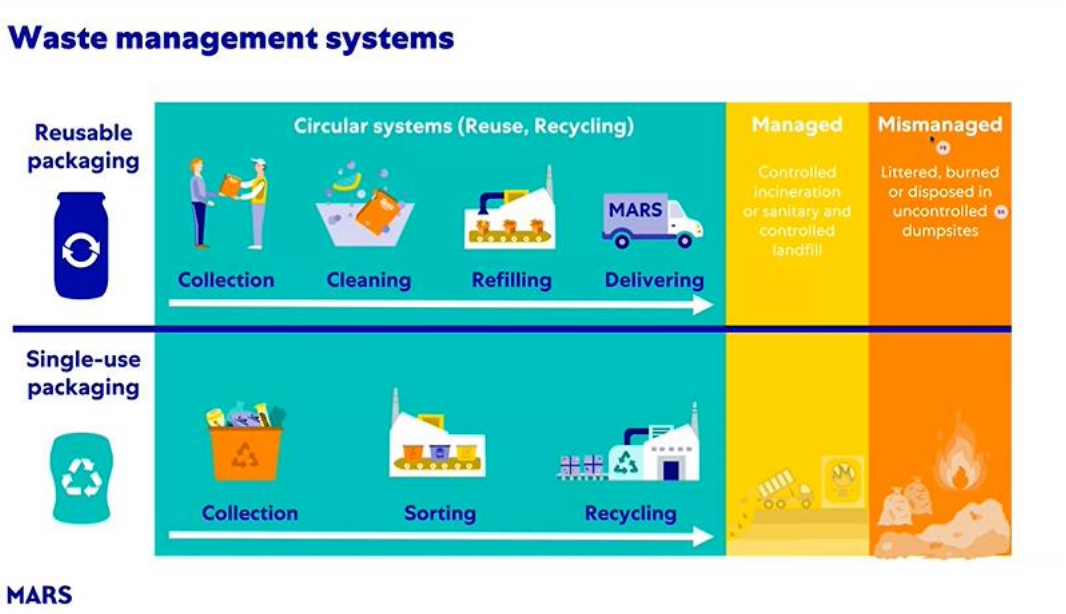
So, the main goal is to have packaging to be circular outside once it's placed in the market. So, this is all about what we are going to focus now to redesign. For the Redesign pillar the infrastructure needs to be well understood and how infrastructure looks like.



Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

Waste management infrastructure.

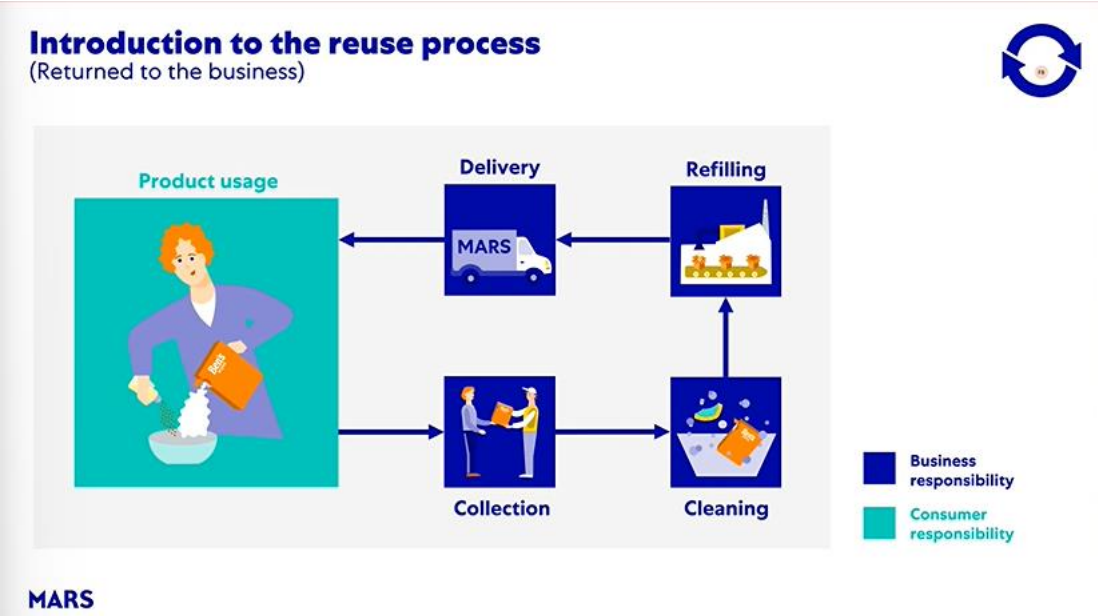
So the waste management infrastructure comprehends two main channels. The first one is about the reusable packaging, that can be used again and again, several times (50, 100, 300 times). In a business model where the reusable packaging is sold, it starts with the packaging collection, then the cleaning phase as need to reuse it, then the refilling process and finally the delivery. At Mars, there are only some pilots with reusable packaging, it is not a big part of Mars portfolio, as most packaging are single use, which is the second channel, connected to recycling and how this packaging is collected. The packaging is sorted because there are different types of packaging materials and are sent to recyclers to transport them to recycled material. And the worst-case scenario is that they end up in the environment.



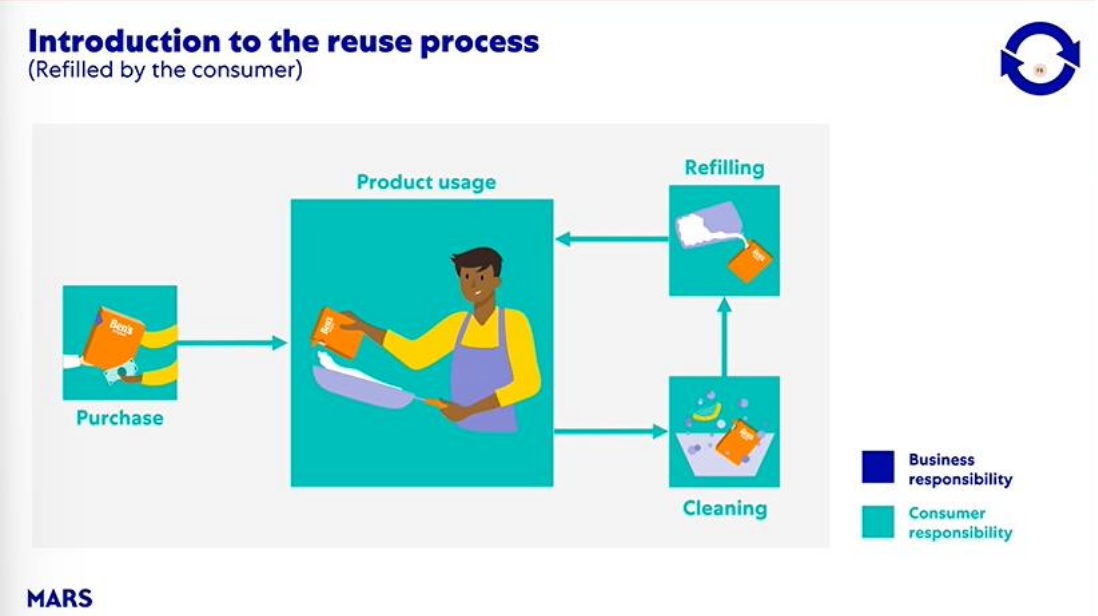
Reuse Process

Reuse process is composed by two main systems. The first one or business models, is about the return to the business. So, meaning that the consumer is going to use the content of whatever was packed. The packaging format then will be collected, and this is under the responsibility of the business, will be cleaned by the business, will be refilled and then delivered back to the consumer. This process is called: the return to the business reusable packaging.

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022



The other case is that the consumer makes the circulation. So, the consumers buy the reusable packaging, use the content, wash the reusable packaging and goes to filling sessions and uses it again.

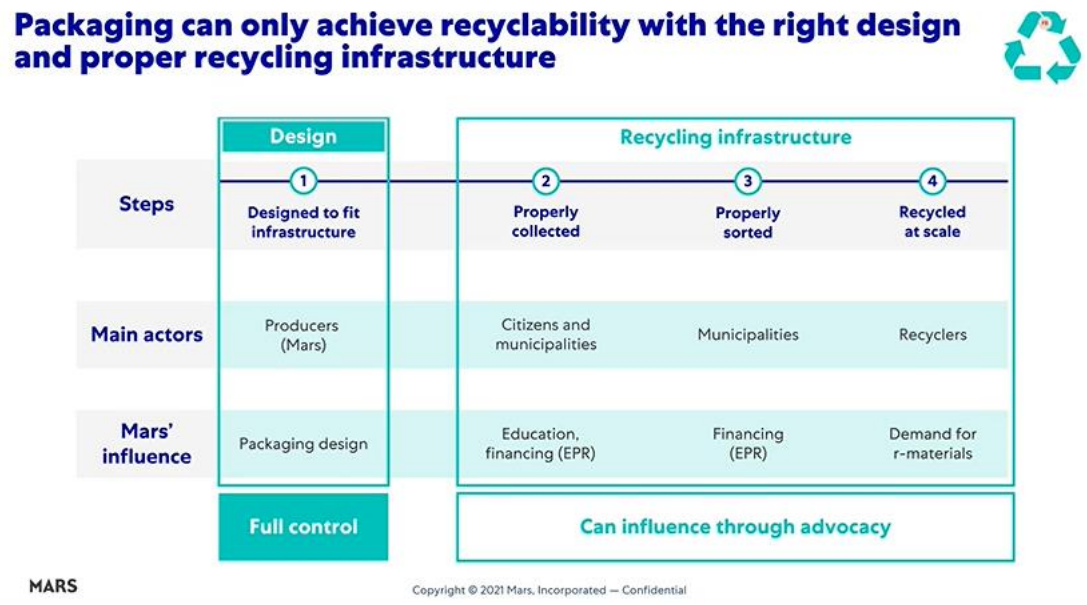


Recycling Process

Recycling is mainly happening with single use packaging. To start with the recycling, it's extremely important to understand the stakeholders that they are involved in this recycling infrastructure. The first one is Mars (companies) that design the packaging. The objective is to design the packaging that has a maximum of chances to be recycled. And this design piece is absolutely in Mars control. Mars decides what types of packaging are put in the market; it is the brand owner responsibility. When it comes to the recycling infrastructure, what will happen with this packaging once it becomes a waste, it is more challenging. It is more challenging because Mars dos does not have full control, Mars can have an influence not a full control. So, the waste management or the recycling infrastructure, it's not directly handled by Mars. The infrastructure is composed of mainly three steps: collection, sorting and

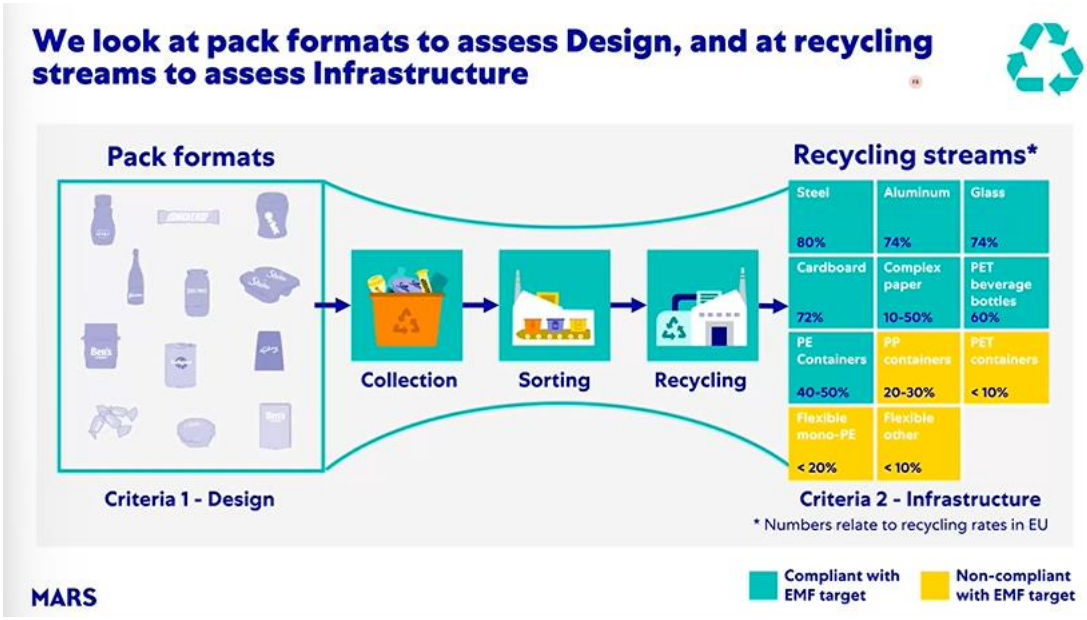
Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

recycling. Usually, the collection and sorting are handled by the municipalities, where there is a formalized way of this infrastructure, the municipalities are the ones that they will put the bins in place so that the consumers throw the packaging in the right bin. They will collect them; they will have the trucks picking the bins and they will invest in sorting centers so that they can separate the different materials. So usually, this collection sorting is done by the municipalities. The recycling is a business such as ours, so they will buy the material from the sorting centers and what they will make investments to recycling infrastructure so that they sell later the recycled material. The challenge with the recycling is that if we add all those costs together, the cost of collection, sorting and recycling, unfortunately it's much higher than the price of virgin material. So, someone need to subsidize this recycling, at least to make a break even. This difference is usually compensated through EPR fees: extended producer responsibility. Financially, as brand owners, at least in Europe, we are contributing to this infrastructure. So that's why Mars and other companies do not have a control but can influence because they pay for the collection and the sorting. And they can also play an important role when it comes to the recycling process because if Mars uses recycled materials in its packaging, Mars is creating a demand and it's easier also for recyclers to make investments by the moment that they know that someone will buy the recycled material.



When looking at the design of the infrastructures and what it's happening, Mars has its packaging formats made with different materials. Those packaging formats will go in a “magical” funnel, like a black box system that will collect, sort and recycle. And it will generate what we call the recycling streams of steel, aluminum, glass, cardboard. When we look at plastics, like for PT beverage bottles, for rigid polyethylene, rigid pp, to illustrate this, for example, the closure of the Dolmio glass jar, which is made with steel, will go to this steel recycling stream. As well as the pedigree can from the PET business will go to steel stream. And the same process happens with plastic, so a gum bottle that is made with HDB will go to a PE container stream and whisk as bottle, milk bottle also made by HDP will also go to the stream. The goal is to design Mars packaging to match those recycling streams that shown in the image. So Mars challenge is to design those packaging with the right combination of materials so that they can go in the right recycling streams, so their chances to be recycled increase.

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022



Value Chain

So what we'll focus on is to understand the value chain which is collection, sorting and recycling. There are different types of collection, such as informal collection, waste pickers in Asia Pacific, Africa or Latin America for example, are people that make a living by collecting packaging and bringing this packaging back to the economy. So they see a value, they will sell it later on and they make a living as such, this is not want Mars aiming to achieve, as the goal is to have a formal system, but it's something that it's happening. Then there are different types of collection, for example, for those that are based in Europe, there are igloos, for glass bottles, for example, there is the curbside collection. Curbside collection consists of bins that you have it in your house, for example. And then the Municipality truck will come and pick it, every week, every two weeks or every three weeks. Or it could also be “on the go” collection, in parks, cinemas, airports, where you have different bins. Whatever it's collected usually will go to a sorting center. There are different types of materials and there are different types of plastics, that need to be sorted, keeping in mind that there is a matter of size that plays a key role. There is a material sorting using different technologies there, or making a color sorting which is also used a lot in the glass and plastic industry to have higher value plastics, when it's white the plastic has more value than when it's black. And then when it comes to the recycling, there are three main technologies:

1) The mechanical one, which is broadly used, meaning it melts the material and makes granules and this material is recycled back again.
2) The chemical advanced recycling, where in the case of plastics, it transforms them to a form of oil or chemicals to make the plastics again.
3) The organic recycling or the composting as such, where the material, even in the case of plastic, but also paper, can be transformed to compost, CO2 and water.

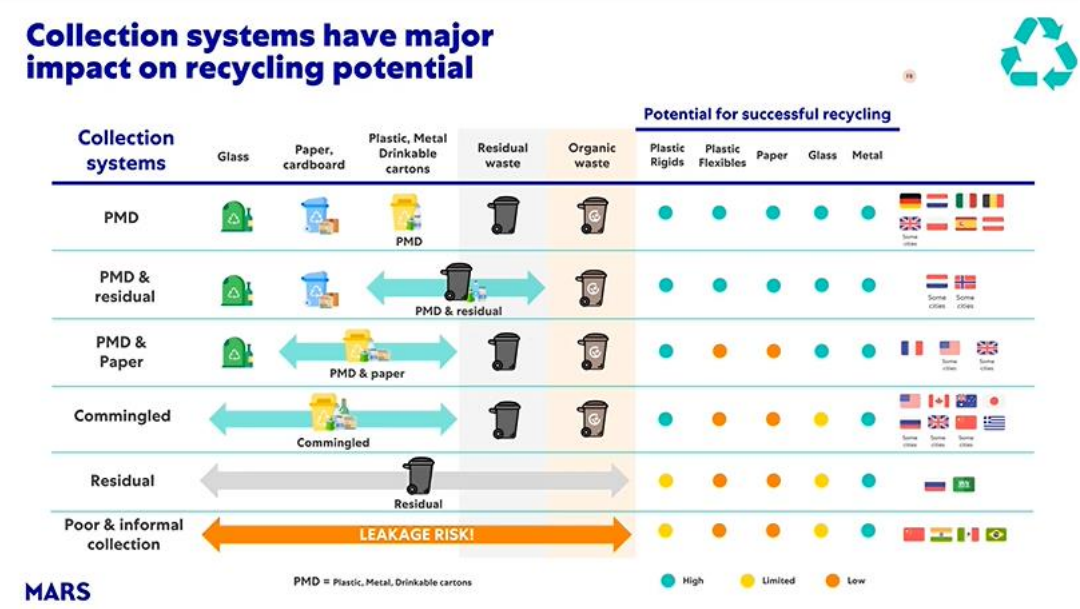
Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

Recycling - Collection

Collection is a challenge, also wishing is was done differently and more in a more harmonized way. But depending on the countries, and in some cases even on the city within the same country, there are different way of collecting the different types of packaging. So to start with the most common way of collecting, the first line in the image shows Germany, Netherlands, Italy and Belgium as well as the five bin systems. So there is a bin for glass, mainly bring points like igloos, a bin for paper, not only paper packaging, but for all type of paper materials. There is PMD bin, which stands for plastic, metal and drinkable cartons. So we can throw all those types of packaging in this yellow bin in some countries, in others it corresponds to a different color. And then there is a residual bin where it's for whatever waste and an organic waste bin, mainly for organic waste. These types of bins are the ones we preferred in Mars and the coral light corresponds to how Mars assess this type of collection on the quality of packaging. So with the PMD collection system, all type of packaging have a very good quality, being rigid, flexible, paper, glass or metal. The way that they are collected gives them a very good quality. In some cases there are alternative of this PMD bin explored in some cities, such as Rotterdam in the Netherlands or Oslo in the Norway, where they collect together this yellow bin, this PMD bin with the residual waste and they are making investments in the sorting in order to be able to isolate the materials. Another variant is the PM&paper where glass is still separately collected, but paper, it's mixed with plastic, metal and drinkable cartons. This is the case of France, in some cities in the US and the uk, Ireland. The challenge with this type of bin is that the paper is a contamination for flexible packaging to be properly sorted. And then the other types of packaging is a contamination for the quality of paper, because paper is very sensitive to food waste. So obviously this is not the type of collection that we are so much in favor, but we see it in few countries. The fourth one is the famous commingled bin that we see a lot in us, Canada, Australia, uk, also a lot in some cities in China they are also starting to introduce this commigled bin. Basically here the idea is to make the life of the consumers easier and having only two bins in a way, one bin for all type of packaging and another one which is a mixture of residual waste and organic waste. In some cases there might be an individual bin for organic waste. The challenge with this commingled bin is first of all the cross contamination of

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

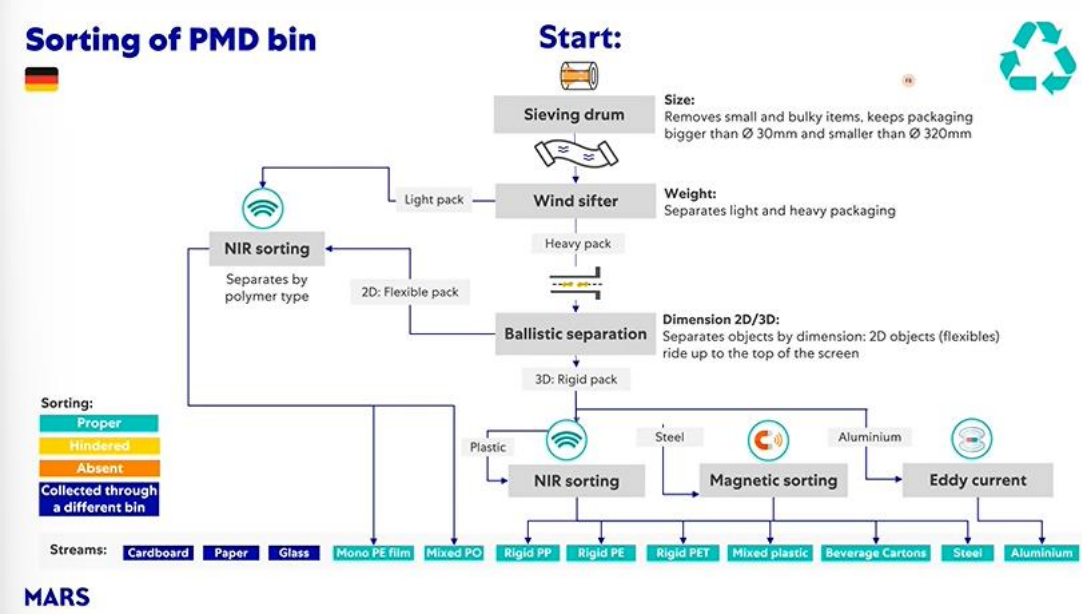
paper and flexibles. So for those who live in those countries with commingled bins, very often are asked not to throw flexible packaging in this bins, because it is more complicated to sort the paper and have a good quality paper, collecting also the glass with this type of bin is not great. We lose in the quality of glass, but also in the yield. So it's not the type of collection that Mars have preferred, especially for a company such as Mars, that has a huge footprint on flexible plastic packaging. And then the remaining two, the main difference is like on the residual bin, there is a collection that wasted are managed and they are not leaking. And the last one is that there is a poor either collection or management of the waste as such. For example, in China we see a lot this poor waste management when it comes to the rural areas while in big cities, there is commingled bin. So there is not an harmonized way of collecting, which is the Mars' North Star, having one of the two first systems, either a 5 bin or a 4 bin. But there is a crucial need to have glass and paper separately collected.



Recycling - sorting centers by country

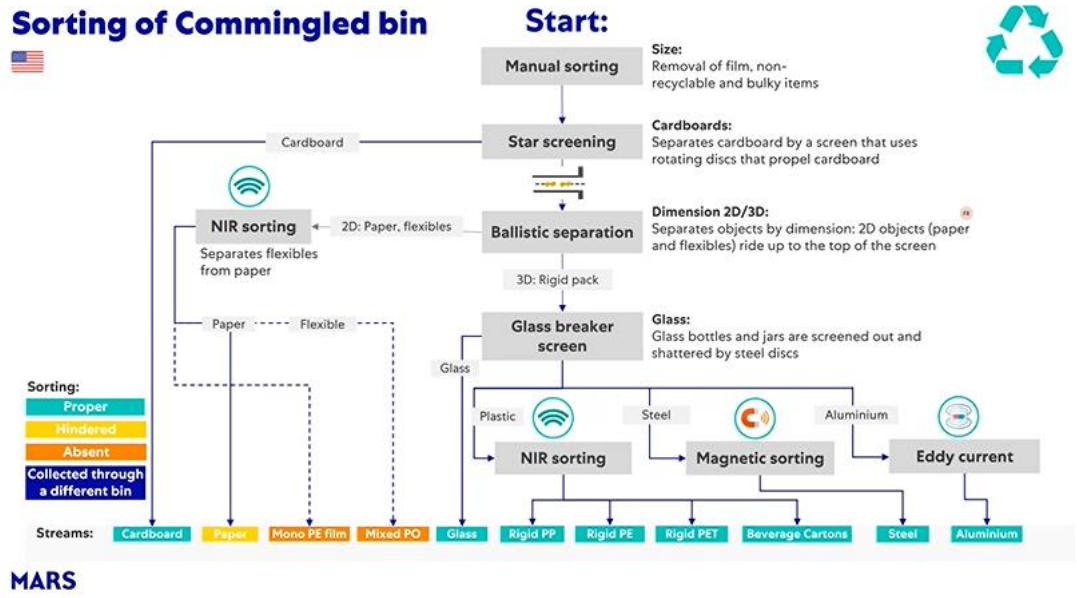
None of the sorting centers are designed in the same way. The placement of the machines, for example, might be different. The image below is oversimplified to show what kind of technologies are mainly they are used in the sorting centers and to understand also why it's important to have the right combination of materials and where they can impact the quality of sorting. The first one, described in the picture, it's about Germany, which present the five bins' scheme. So cardboard, paper, and glass are separately collected, while plastic, metal and drinkable cartons are collected together. Plastics means all types of plastics, including flexible packaging. The first step of the sorting process is called "sieving drum", which consists of removing either the very small packaging, but also the very big packaging, that can interfere later with the sorting process. Once we have passed this step there is what the "wind sifter", which is like a hoover that is going to wind sieve the very light fraction of packaging and this light fraction of packaging is mainly flexible packaging. So, for example, sneakers float up will be wind here in this step, it will go with this light pack fraction here and then, after the wind shifter, if there is still a mixture of rigid and flexible packaging, they will go to the "ballistic separation". And this is mainly a separation of a two-dimensional and a three-dimensional packaging. So, for example a bottle, it's a three-dimensional, a pouch, a pet food pouch will be two-dimensional. So, a pet food pouch that was not wind sifter and still remained with the other packaging will go in this ballistic separation the 2D packaging will be separated from the 3D. So the pouch here will be separated and then what will

remain after the ballistic separation is whatever, it's a three dimensional packaging. All the flexible packaging, in this particular case in Germany, will go up later on to what we call a NIR (near infrared) sorting, used to separate and the near infrared will detect the plastic that the packaging was made of. And in the case of Germany this packaging will be divided in two recycling streams. One it's a monopoly ethylene film and the other one it's a mixed, called mixed polyolefin, a mix of polyethylene and polypropylene. All the remaining rigids, so the plastic and beverage cartons will be sorted through near infrared by using the same technology. So we'll have a recycling stream, pp, polypropylene, polyethylene, pet, in some cases also mixed plastic, but it's not very well valorized. The beverage carton, which is the tetra pack type of packaging, the steel, so the tons or the closure of our jar will be sorted with a magnetic sorting. And then an aluminum tray or an aluminum can will be sorted eddy current. Both the magnetic sorting and eddy current are very powerful and efficient. So whatever metallic packaging is collected and end up in the sorting center will be well sorted. When it comes to the plastic, the more is a mono-material packaging, the higher are its chances to be properly sorted. And again, when referring to the design guidelines, it's important to keep this in mind and the technologies that we use and why we will need to use a certain combination of materials, decoration, color, thickness, for example, is because it plays an important role to sorting.



The following image shows the US sorting process. In this case, all types of packaging, they are put together. Also this case is very simplified, it starts with manual sorting, removing bulky items or whatever it's not recyclable, next the star screening to remove the cardboards, like big pieces of cardboard. This step is quite well separated, even with this type of collection, because it concerns big pieces. Then it is extremely important to understand the challenge with flexibles and paper in the ballistic separation where it's a two-dimensional and three-dimensional separation. In the case that paper is collected together with flexible packaging and plastic, because it's two dimensional, the flexible packaging will be going in the two dimensional fraction and will be going together with paper. So that's why for commingled bin type of collection offered by municipality, usually municipalities ask not to throw flexible packaging in your bin because they don't want this flexible packaging to contaminate the paper stream. They are some sorting centers that they are trying to add near infrared technology to separate the plastic from paper. But still this remains a challenge and especially the grade of paper or the type of paper packaging used, for example the rice paper box will have a challenge to

be properly separated with this type of collection. Then they have the “glass breaker screen” to remove the glass, breaking the glass. So that's why the quality of glass it's lower. And by breaking also the glass, you are contaminating the other material stream. So it's not ideal either to have the glass collected there. And then US uses the same technologies seen for Germany to separate the the rigid plastic packaging with near infrared technology. Magnetic sorting for magnetic sorting for meta for steel and eddy current for aluminum.



Recycling -Treatment

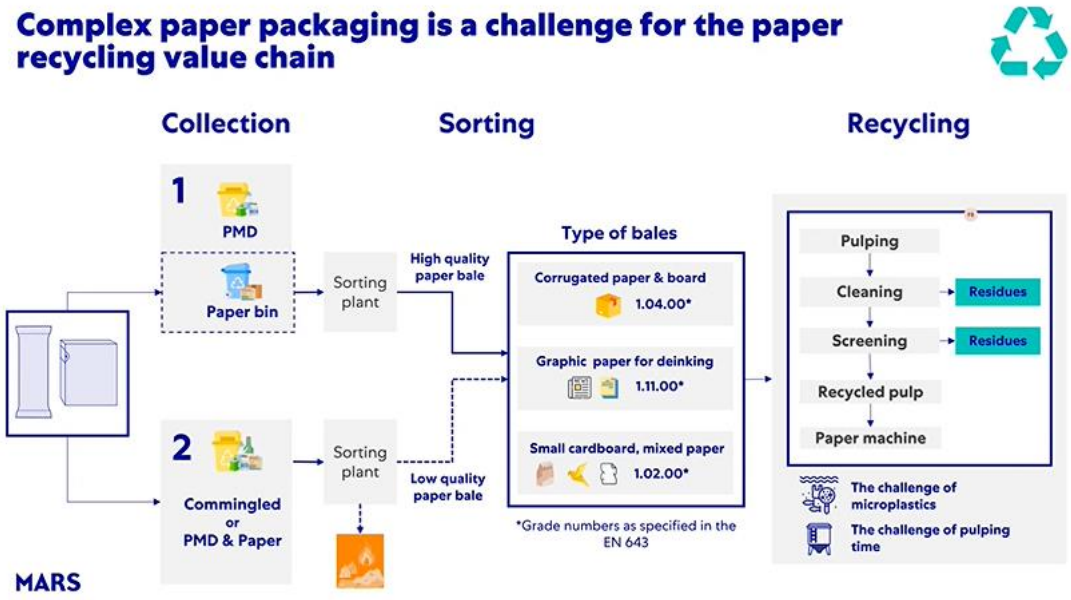
This section will show what happens once the materials are sorted in the recycling. Let's start with the easy ones, the ones that are well Recycled: glass, steel and aluminum. Glass can either be collected through bring points or through the commingled bin. Bring points are better because of the higher quality and higher yield, usually no need of sorting to separate it. Whatever it's collected goes to glass recyclers where the sorting of color occurs. But no need of sorting to separate it from other type of packaging. While in case of commingle bin collection, the glass can be sorted with a glass breaker screen, although this path is not preferred when it comes to steel like cans, the closure of glass jars, which can be collected with a PMD bin or the commingled bin. And here, whatever the collection used, the quality and yield are quite good. Cans will go through the magnetic sorting and by the moment that was collected, most probably will be recycled. Same thing happens for aluminum, which it's not sensitive on the type of collection. By using the eddy current and then the aluminum smelters to make aluminum again. In the case of aluminum usually the beverage cans are collected through a deposit, meaning that the packaging might go back to food grade applications. The aluminum beverage cans or whatever aluminum collected through PMD or commingled bin, it does not have this high quality to usually go back to food grade applications, but it will go in other applications. It is important, although it is a detail, that for steel and aluminum, especially in countries with incineration, that steel and aluminum can be covered from the ashes. Recovering a lot of steel and aluminum from the ashes from incinerators makes the recycling rate for steel and aluminum extremely high in Europe, like 80 and 75%. There are not these high rates for other or in countries that don't have incineration.

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

The next image illustrates the paper recycling process. Paper has its own challenges depending on the type of paper, whether it is primary packaging, for example a paper floor up, for which barrier properties are needed. This paper will be mixed with plastic which will give the barrier properties, influencing what happens with the collection and with this type of paper. There are mainly two parts for paper: it is either collected, as in the German system, with the five bins, where there is a dedicated paper bin combined with the pmd and consumers can throw the paper in this dedicated paper bin, or the commingled or the PMD and paper bin where paper is combined with other type of packaging materials. In the first case, since only paper is collected, there is a very high quality of paper from this collection. In the second case, the quality is quite low. In some cases, it might be recycled, but in a lot of cases might just be incinerated or landfilled because the quality is too low, like through commingle or PMD and paper B. So once collected, the paper will be sorted and basically there are three types of paper bales: the first one is the corrugated paper and board, which is what is driving the market today. For example, the cardboard Amazon or in general the ones sent to retailers. This paper is extremely well recycled, because it is quite heavy, has a very good collection system and it is easy to collect, sort and recycle. The second type of paper is what we call the graphic paper for deinking, for example newspapers and magazines, so not packaging. And the third type of bales is what we call the small cardboard or mixed paper, for example the Ballisto paper floor that we launched in Germany. If this last type makes it through the sorting, it will most probably end up in mixed paper fraction, which although it is recycled today, not at the same level as a corrugated paper or board. It really depends on the country, as well as the type of collection. The last step is the recycling which consists of taking the paper, pulping it in this process, then cleaning, screening, producing the recycled pulp that will later be used to make paper. It is important to keep in mind that for packaging, the complex paper packaging which combines paper with plastic, there are two challenges: the first one is about microplastics, meaning that the recycling process is using a lot of paper and to pulp the paper, a lot of water is used, which is just discharged, going back to the environment. So, residues, and in particular plastic residues might end up directly to the environment. Therefore, it's extremely important to properly design complex paper packaging and the materials used either for the layer or the coating with the paper. The second challenge for the complex paper is the pulping time, a corrugated paper is just paper which will be easily pulped. But, in case of a mixture of paper with plastic, the pulping process is more challenging

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

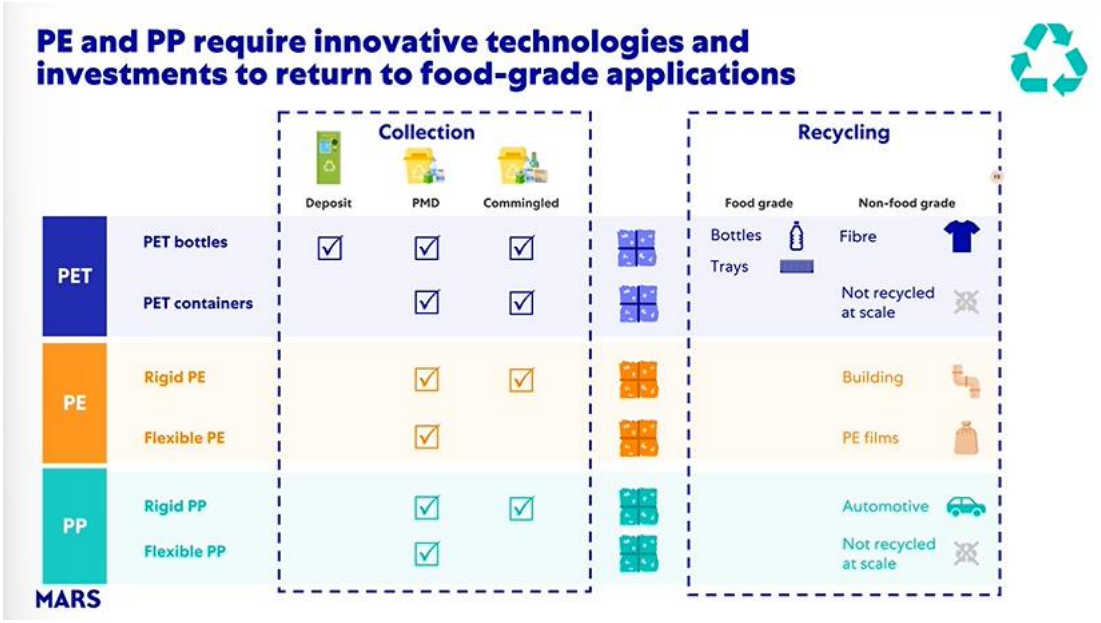
and more time consuming. This is why it is recommended to run a palpability test, to understand if plastic will be separated from the paper and will be able to be recycled.



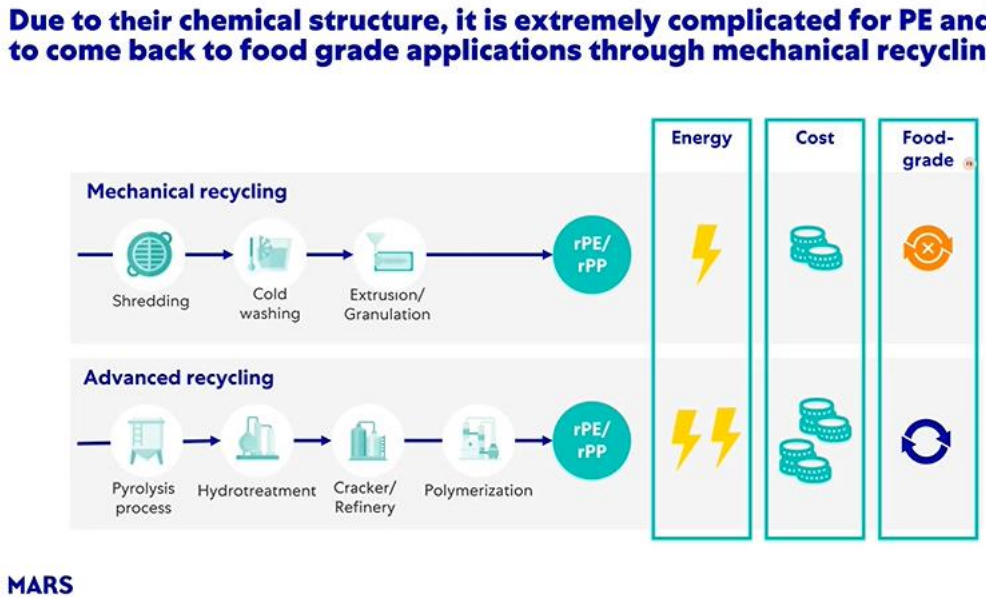
The last recycling process concerns plastic, having three main plastic resins. More than 80% of the packaging being PET, PE, polyethylene, PP, polypropylene. The PET is the most famous one because it's used in the for beverage bottles and it's the best recycled today. But when it comes to beverage bottles, it can be collected through deposits. So, in Nordic countries, in Germany or in the Netherlands, there are deposits where to bring this PET bottles back, or they can be collected also through a PMD or commingled bin. And usually, PET from the beverage bottles is able to go back to food grade applications, either making bottles again or trays PET trades. The PET trays market is using huge amounts of recycled pet. In China, the PET bottles are mainly recycled into fibers by the clothing industry, the apparel industry. However, when it comes to whatever is not a beverage bottle, but it's still PET, recycling it becomes a challenge. They are not recycled at scale today. There are a few countries putting in place a recycling stream for whatever is not a PET bottle, but still at the beginning. The second resin, the polyethylene, both in rigid and flexible application. The rigid application will be a gum bottle on hdpe, and flexible application will be our pet food doggy bugs that are mainly in a polyethylene structure. As we saw rigid can be collected through a PMD or a commingled bin and can be quite well sorted later. When it comes to the flexible packaging, the five-bin system is required to for the collection. It is challenging to have flexible collected and properly sorted with a commingled bin. Usually from rigid pe it is possible to build pipes materials. There are a lot of studies to bring PE back to packaging applications, in some cases also to food grade, but in a very limited way. Some examples are the shampoo bottles. And when it comes to flexible pe, it's mainly recycled today to make garbage bags. So, garbage bags are made of the recycled pe. This is a saturated market; this is why flexibles are not recycled at scale as we would have wished and is the case of PET beverage bottles. Because this market is quite limited. When it comes to PP, it is very similar to pe. So, the rigid ones can be collected and sorted through the PMD or the commingled bin. While the flexibles have a limitation with the commingle bin. The rigid pp it's mainly used in automotive applications, but also to make garden stuff like park benches. A flexible PP today it's not mechanically recycled at scale, and this is why we need the advanced chemical recycling. For flexibles, we have a limitation on the mechanical recycling and the recycled material that is obtained for flexibles after the mechanical recycling. The challenge is the

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

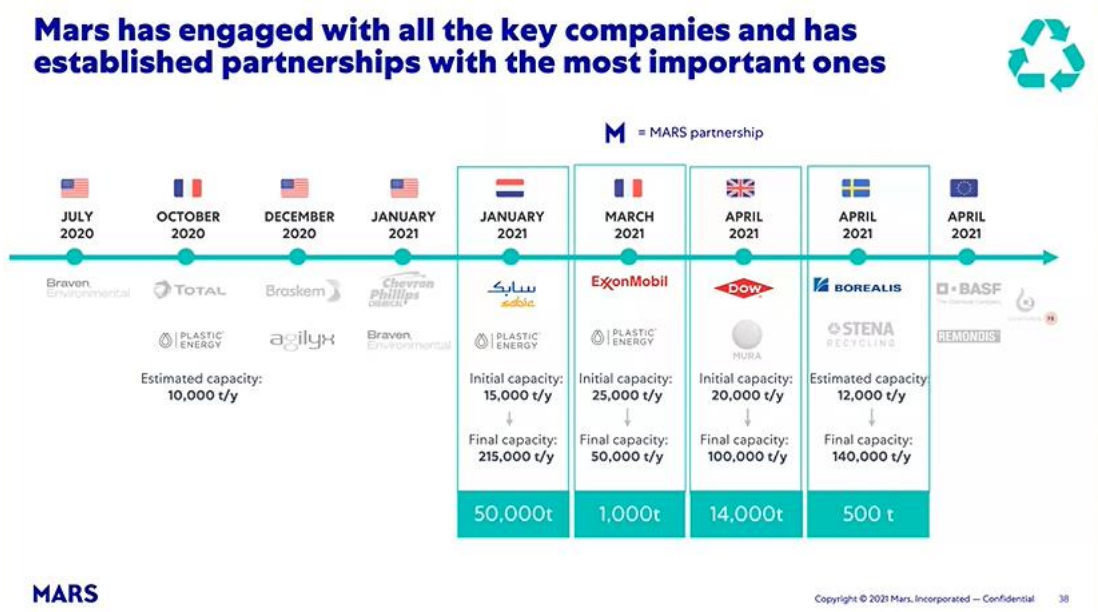
difficulty in finding the market later. The advanced chemical recycling is so important although it might be more energy intensive or more costly.



The image shows a big picture on the mechanical recycling: there is a shredding step, then washing and extrusion. In the chemical advanced recycling, there is the pyrolysis process, where the plastic is transformed into a form of oil, which will go back to the industry. There are more processes for the advanced chemical recycling, meaning more energy, more cost. But the advantage of the advanced recycling is the possibility to go back to food grade application and open this market or the opportunity to sell the recycled material. This means having this responsibility of closing the loop which today it's much more complicated through the mechanical recycling. And for PE and pp, not for pet, will very quickly finish here before going to the composting. In the next coming years this will be something that will scale making it possible to recycle this type of packaging, particularly the flexibles at scale.

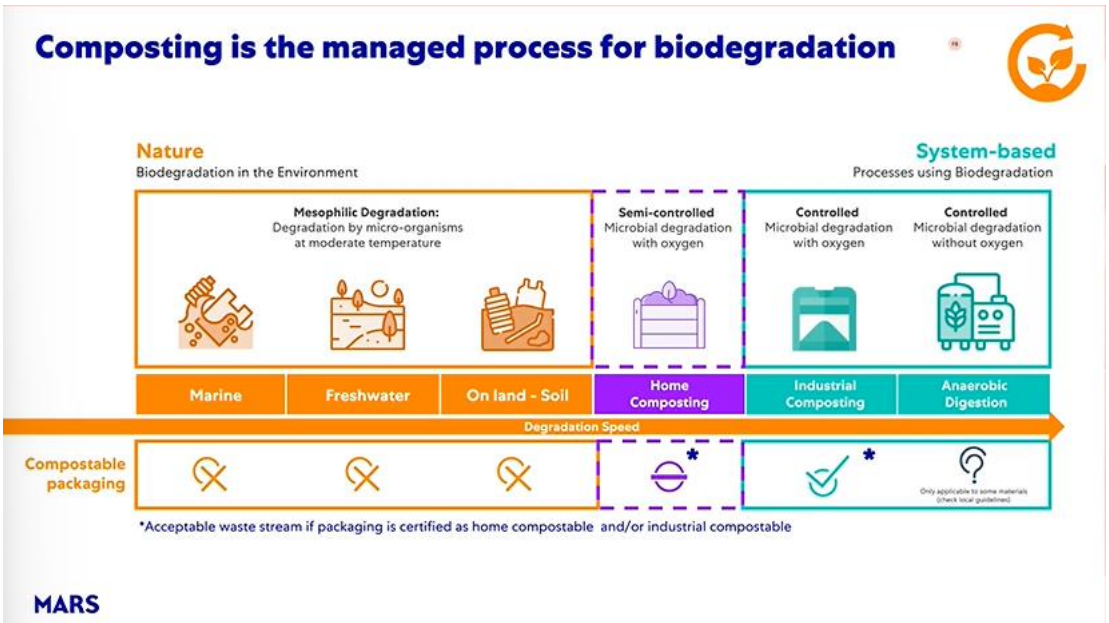


Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022



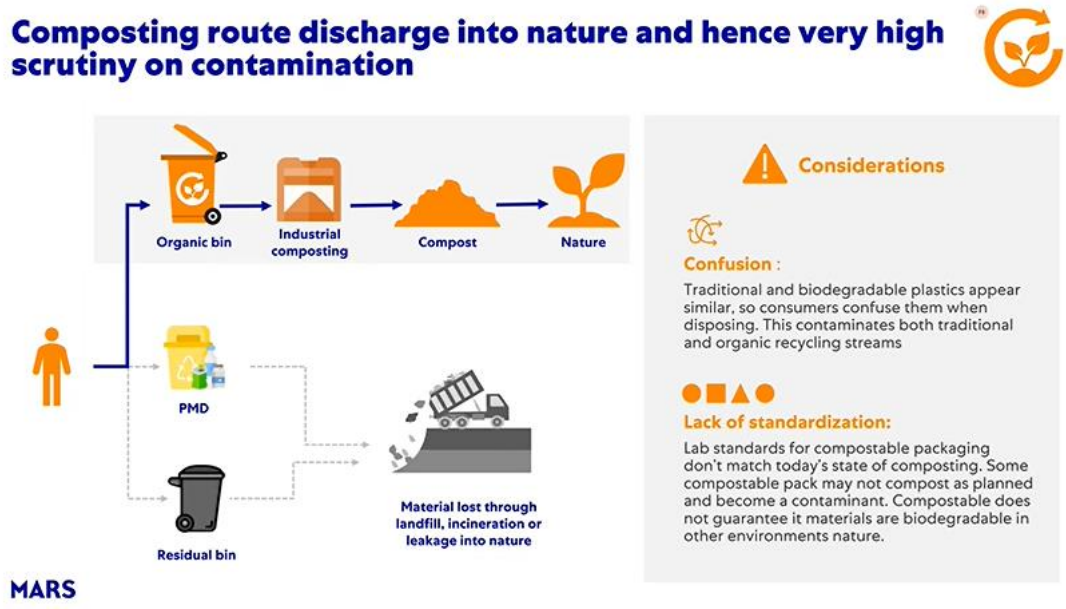
The composting

The composting is a process for biodegradation, which if plastic material is left in the environment, it will be transformed through microorganisms to compost in organic, CO2 and water. The goal is not to make the nature to play this role. Even though there are biodegradability certifications for marine, freshwater and land. It is possible to check how long it takes for materials to biodegrade in those environments, but the nature should not be taking this role. A better solution is to control it, through industrial composting or an anaerobic digestion. In this way, the temperature and the humidity are controlled so that the biodegradation happens faster and the material is transformed to compost.



The challenge with the composting process for Mars' packaging is first its collection, to avoid that the packaging ends up in the environment and biodegrade. To achieve the goal of composting the packaging, the first challenge is to make the compostable packaging to look and feel differently from a conventional plastic packaging, in order not to create confusion in the consumer. Throwing the

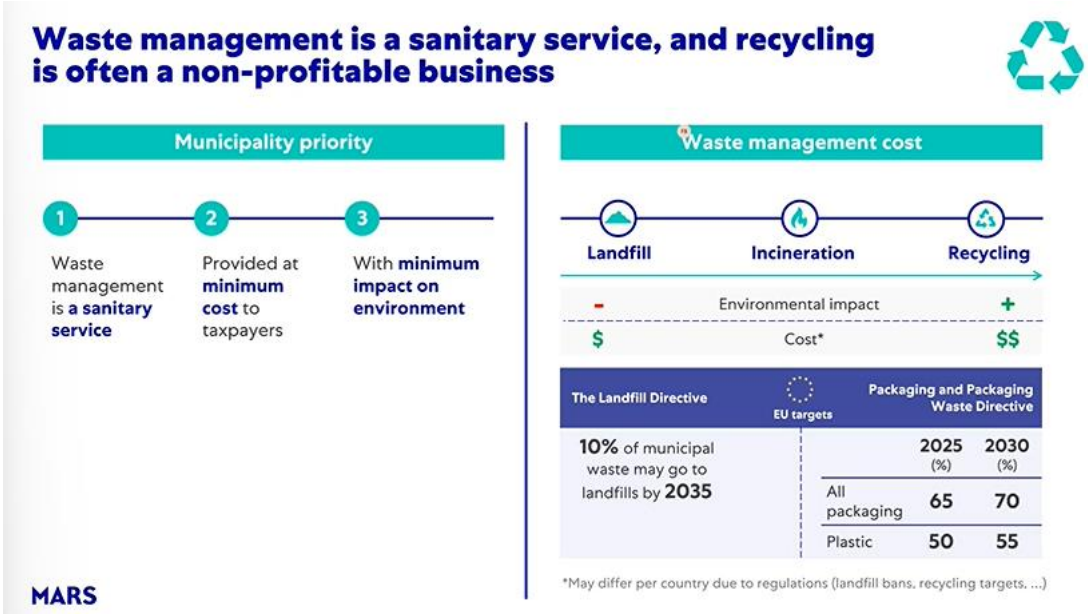
packaging in the right bin might be a challenge and a similar challenge occurs also with paper. A particular challenge in Europe is that a lot of the municipalities do not really accept packaging in the organic bin. So they want this organic bin to be dedicated to food waste or garden waste, but not packaging. Mainly due to the challenge of the confusion. The other challenge is standardization, meaning how long this industrial composting process will last. Is our packaging, if we develop a compostable packaging, is it going to match those times? This requires preparation and certifications that are associated with composting and its packaging.



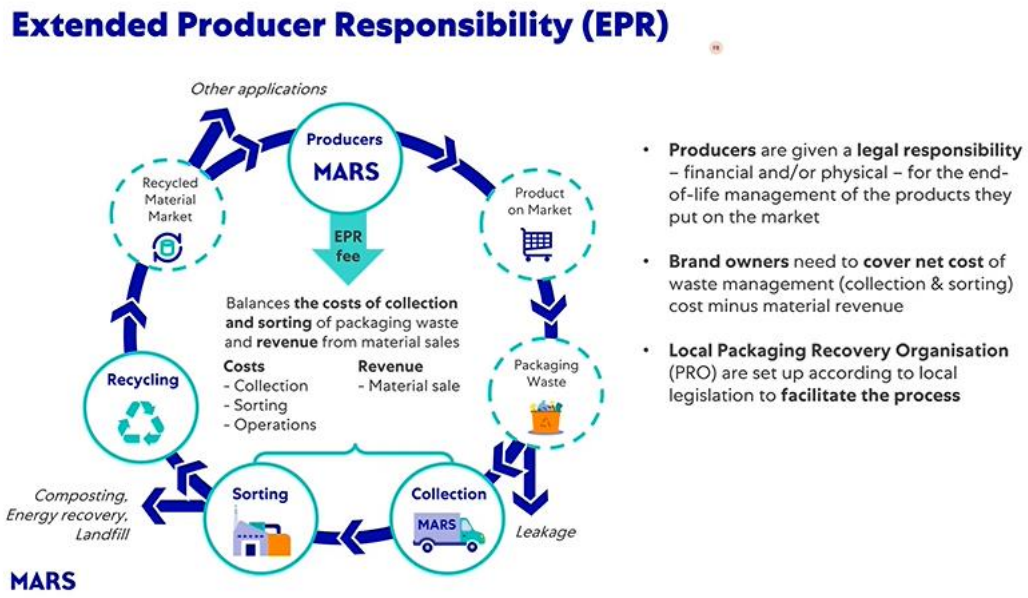
EPR Schemes

EPR schemes started in Europe to finance this waste management system that needed more money than just landfilling or incineration your waste. Municipalities had three options to treat waste: landfill, incineration, recycling. Landfill obviously is the cheapest one, but it's also the one that has the higher environmental impact. A similar situation occurs for incineration, which is cheaper than recycling and a little bit more expensive than landfill, but still has an environmental impact, the material disappears, and we get energy, but the material is just disappearing. And then the recycling, which is the most environmentally friendly, but at the same time the most expensive one. So, what happens in Europe, and the rest of the world is following this trend, is that the European Commission has put laws in place, directives in place, to make sure that the municipalities will do their best on reducing the landfill. So, there is a maximum of 10% of municipal waste going to landfill by 2035 in Europe. This target has the aim to motivate the municipalities to recycle. For all type of packaging, it's 65% by 2025 and 70% by 2030. And when it comes for plastic packaging, it's 50% by 2025 and 55% by 2030. The goal is to force the system to go in the direction of recycling and make recycling more attractive, otherwise municipalities would have chosen the cheapest option.

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022



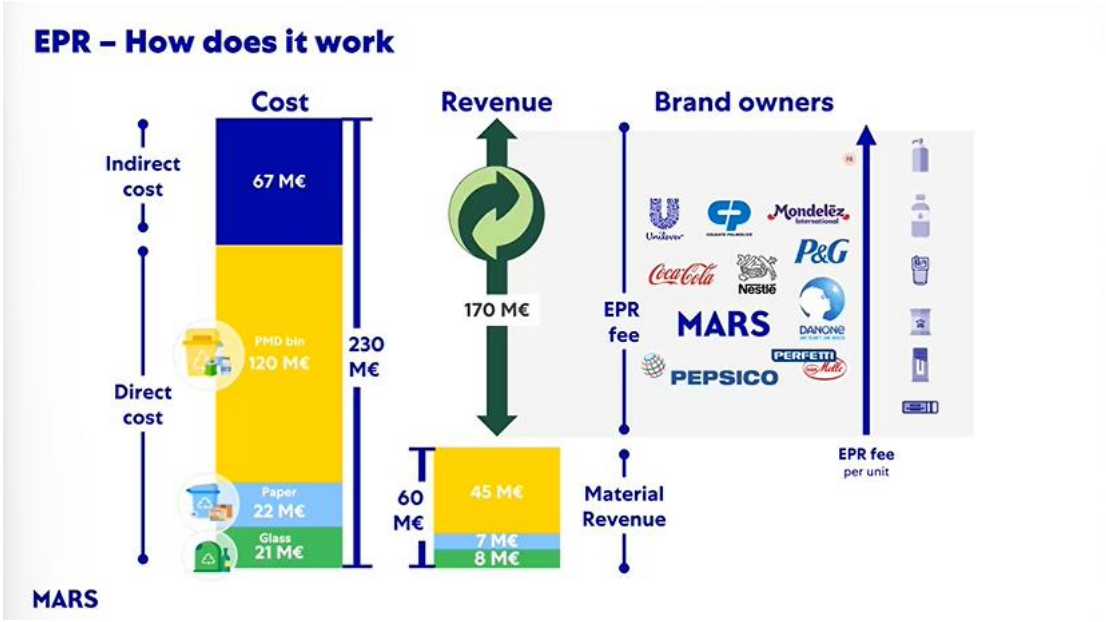
The point is that the recycling is more expensive than landfilling or incineration, so in Europe, the solution implemented to cover the recycling costs is the extended producer responsibility (EPR). Meaning that Mars and other brand owners take the responsibility of the waste generated by their packaging. Mars also did this to avoid paid taxes to the governments or the municipalities for Mars packaging as Mars waste is more expensive to recycle. So, Mars will take this responsibility and put a system in place to handle this cost.



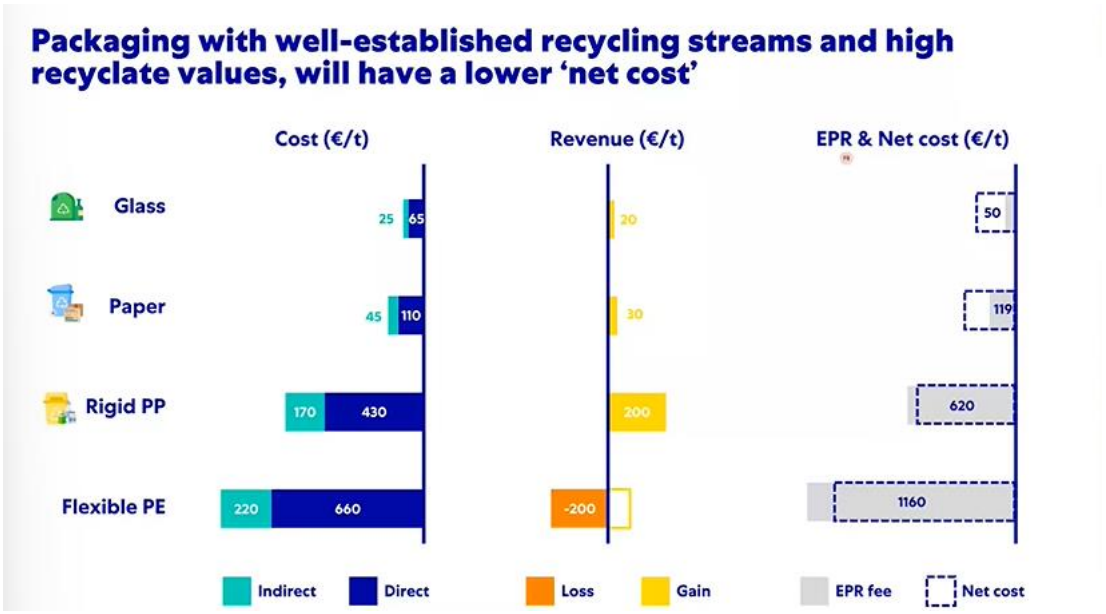
For example, in Belgium, where there are 11 million people, to implement a recycling system, it costs 230 million: 67 are the indirect costs and the rest are direct operational costs, like the PMD bin, trucks that they will need to collect them, corresponding in this example to 120 million. In the case of Belgium there are 22 million for the collection bins for paper and 21 for glass. The challenge is that this cost of collection and sorting, it's much higher than the revenue that you can get if you sell these materials. So, for example, in Belgium, to sell whatever was collected and sorted from the PMD bin, you only make 45

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

million from the 120 million that you needed for the collection sorting. Even for paper and glass, that we think they are well recycled, the revenue in the case of paper is only 7 million, while the cost is 22 million, for glass is 8 million, while the cost is 21 million. This gap is the epr fee, the difference between the cost and the revenue, which in the case of Belgium is roughly 170 million, which is paid among the brand owners.

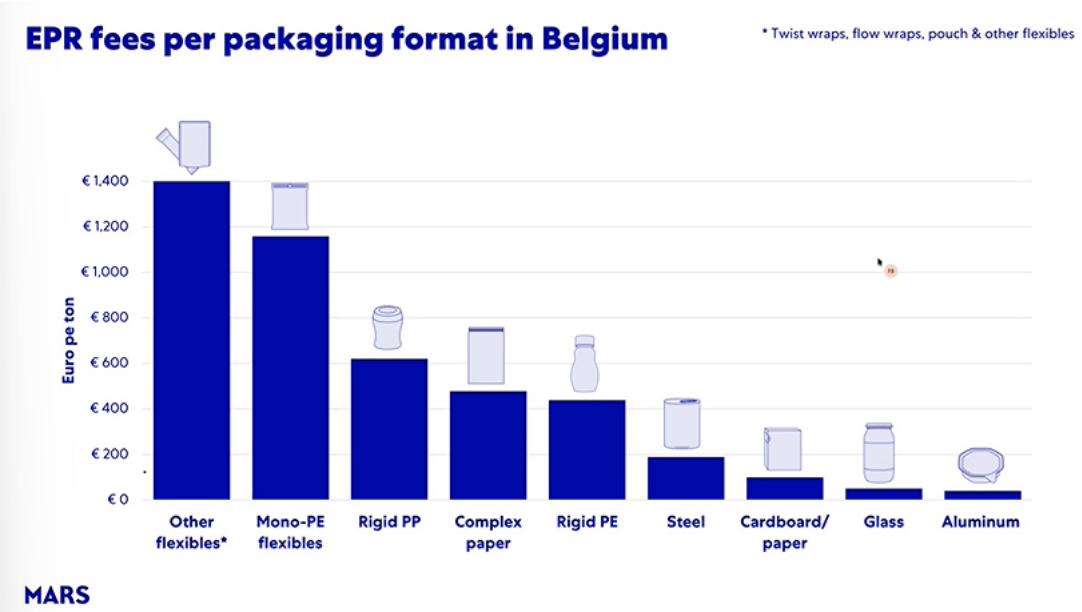


The challenge is how to distribute this 170 million in a fair way. This fair way is based on the net costs. So, for example, glass has a cost of €90 per ton and it brings the revenue of 20 millions, so the net cost is around €70 per ton. EPR fee in Belgium will be around €50 per ton. For paper, there is a similar situation. While when it comes to plastic, it is a little bit more challenging. In case of rigid PP, the fixed cost is €600 per ton and its corresponding revenue is €200 per ton. In the case of a flexible packaging, the costs are even higher, like €900 per ton and there is no revenue in this case but an additional cost to get rid of the materials, so the revenue is a negative cost of 200 million. So, in the case of rigid PP, the EPR fee will be around €600 per ton, and in the case of a flexible packaging will be 1100. And based on this net cost approach, we have the different fees for different packaging formats in Belgium.



Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

So for example, a glass will pay around €50 per ton, where a mono-PE will have a cost of €1,100 per ton. The following image shows the ERP fees per packaging format in Belgium:

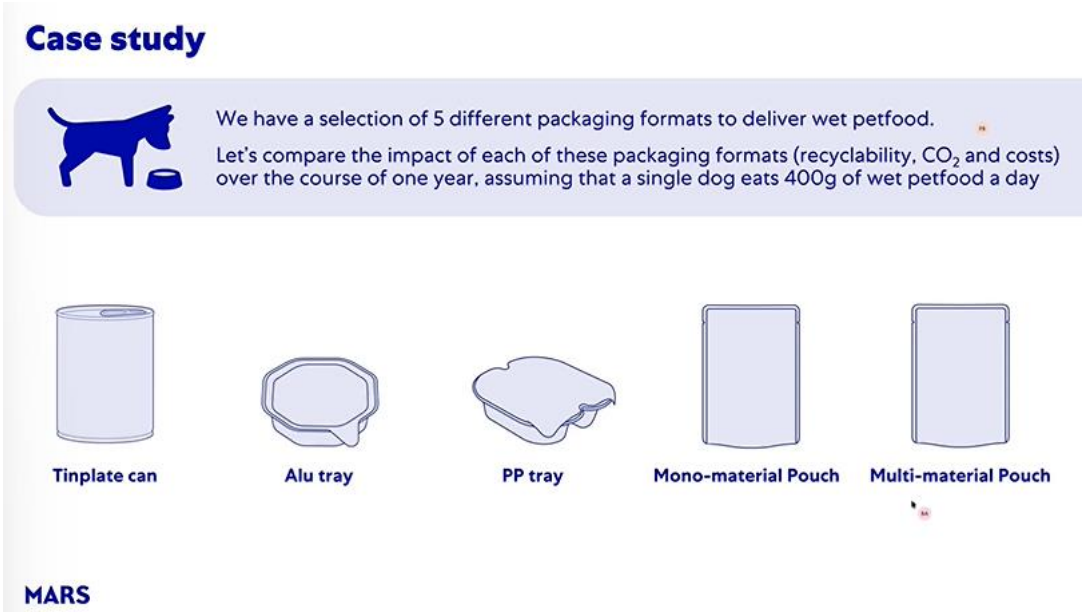


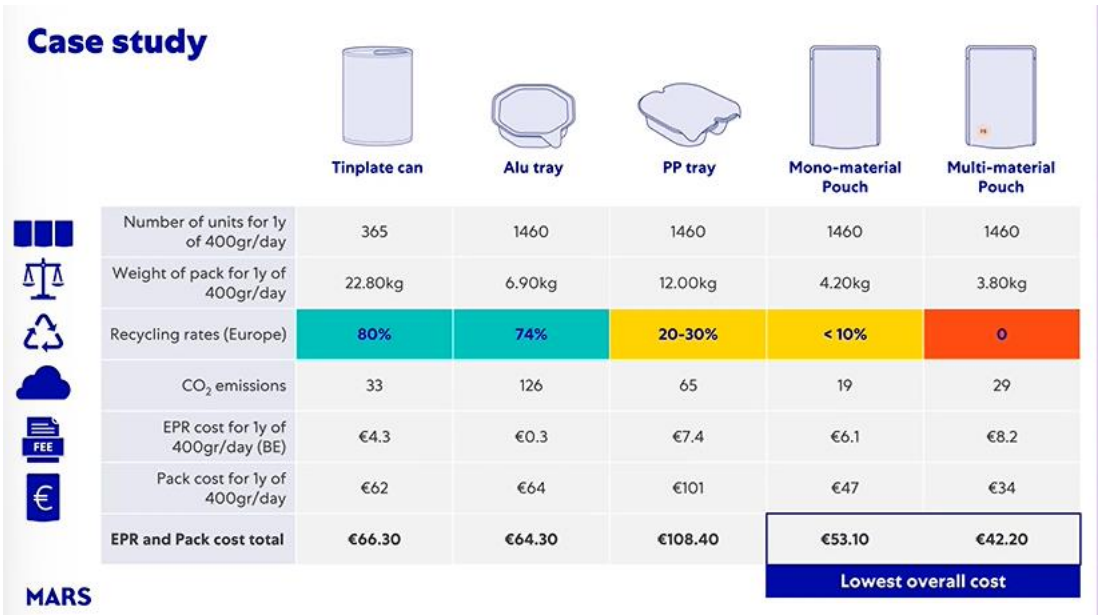
Case Study

Imagine that Mars needs to deliver a wet pet food and let's assume that a dog consumes 400 grams of wet pet food per day during a year. In this case, we have basically four plus one options to pack our wet pet food. The options are can, aluminum tray, polypropylene tray, mono-material pouch and multi material pouch. If we look at those options in one year in terms of units: A tin can, usually it's going to deliver in one serve. For 400 grams a day, one can pack 400 grams. So in a yearly consumption, 365 units are needed. For Aluminum tray, a PP tray or a pouch can fit 100 grams, so 4 times 365, which is 1460 units. From a weight perspective, in the case of the can, it is approximately 23 kilos. In a case of aluminum tray is 6.9 kilos, for PP tray, 12 and for the pouch that is so light, it is around 4 kg in a year. As we saw, the recycling rates are quite favorable for the can and the aluminum tray. The PP tray in Europe, like the PP recycling stream, it's around 20 to 30%, the pouch is less than 10%, and the multi material, because it's badly designed, will have no chance to be recycled. The CO2 emissions here are quite high for aluminum because we have assumed that we use verging material. In the case of the can, we assume that we use 60% recycled material. But again, here we see that the pouch has the best results from a CO2 perspective. Now let's look at the cost. So you saw that for a pouch, it's extremely expensive when it comes the price per kg and the can or in aluminum, it's very low. But when we put all this together and based on the weight that we need in a yearly consumption, we see that the order of magnitude, it's quite similar. So in the case of a can, we'll need like €4 in this year, aluminum, it's quite attractive because aluminum has very high revenue, so it's almost going to cost nothing on EPR fees, PP tray will be €7 and the pouch, the mono-material one will pay 6 and the multi material one will pay 8 because it has a malus, because it's a multi-material. When comparing this in the perspective of the cost of the pack as such, we see that it's quite small when it comes to the cans and aluminum, it becomes, in a ratio perspective, it becomes important for the pouch. But overall, the cost is still

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

cheaper for Mars. The EPR fee price is very high for the pouches, but it's still cheaper to sell in a pouch compared to a can or a tray. So despite the higher cost that Mars might be asked to pay on EPR fees, if those EPR fees will allow to increase the recycling of those pouches that today are not recycled at scale, then we are okay to pay those EPR fees, even though being higher. So, the point is that Mars can use all types of packaging and even for the flexible ones, even with high EPR fees, it still makes sense for us to pay those EPR fees and pay our responsibility to have them recycled, because this process will bring circularity for the flexible package.





Q&A

1. **When considering the EPR fees according to the type of packaging material, it seems there's no direct incentive for Mars to change or redesign our portfolio. Is that correct? How will the**

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

new EPR scheme encourage this shift in mindset, potentially using EPR funds to create an incentive? Otherwise, what would motivate us to change over the next three years?
There are two types of comparison there: one among different types of materials and the other in the same packaging format. For example, when we look at the pouches, the one that it's mono-material and the one that is multi-material, the mono-material will pay €2 less, so it would make sense to optimize the packaging reducing EPR fee. But the choice of materials depends on what the brands want to do, depending on their values. EPR are important to finance the system but on the choice of the material being used, it's up to the brand and the story that they would like to tell consumers.

2. **Are there any regional breakdowns of our recycling rates?**
   Yes, they are. But this is an extremely complicated topic as the breakdown, it's also not per type of packaging format, but they are some regional breakdowns, and we'll work on it to give you as much data as possible.
3. **Are the numbers for EU material recycling rates inclusive of the UK?**
   I don't know if the material recycling rates are inclusive of UK but, the recycling rates in UK for some packaging formats are quite like the EU, Like for steel, aluminum.
4. **We know that certain colors sort less well is there any central testing for our brand colors that can be shared? (ex. Whiskas purple or Pedigree yellow)**
   Yes, dark colors in general will perform a little bit less well than light colors is EPR fees because Mars uses near infrared spectroscopy dark colors.
5. **Is the EPR fee covers the cost for generate more CO2? Or that would be another topic?**
   No, EPR fees are not covering CO2. There are some countries that try to have a malus/bonus system based on lcas like lifecycle assessment and emissions like if a packaging has higher CO2 emissions is going to be penalized but we try not to do so because we really want the EPR fees to focus on subsidizing the cost of collection.
6. **During recycling, do we know what proportion of potential recyclate is lost in the first step of sieving or manual sort?**
   It depends on the materials but it can be from 20% to 30% from the moment that we have a bale that it's sorted, until the recyclates put out at this extrusion process.
7. **In recycling section, is the percentage of materials recycled in the EU also including the UK? Furthermore, are store drop off for soft plastics factored also?**
   Not sure if UK was included. The store drop off is a great initiative to engage consumers, but it has small impact, about 1% or 2% of all flexible packaging sold in the UK. What Mars would have loved is a curbside collection of its flexible packaging, but a transitional period would be required, and Mars might need to go through the store drop offs but it's not at all big on impact on the collection.
8. **In collecting system, you share the speed of infrastructure globally for waste collection by municipalities. UK recycling split across three systems; how is Mars influencing government to standardize waste collection?**
   Mars is working hard on standardization. It's a good point and it's not only about UK but also in Europe Mars is looking forward to harmonizing better the systems.
9. **What EU/UK NGOs are Mars partnering with to keep pace with industry dynamics/ legislative change - and influence governmental decisions making for optimized waste management in the future?**

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022

Yes, we are working not only with NGOs, but also with our peers. The flexible plastic initiative that Mars have launched together with Unilever, Nestle, PepsiCo and Mondelez. So, it's a call to action to improve the collection, sorting and recycling of flexible packaging. Mars is very closely working with the LMCAR Foundation and wwf. So, it's a hot topic, the change of the infrastructure and how mars can improve it all the different stakeholders involved.

10. **How is EPR managed? Is it by project?**
    No. Mars still needs to harmonize it internally, but Mars usually pays, at least in Europe it's mandatory to pay this fee. So, in every country that operates in Europe it is mandatory to pay for the EPR fee. So based on the volumes of packaging that are put in the market, there is a calculation of the EPR fee.
11. **The case study is only based on the Belgium costing and infrastructure, so if considering other countries cases, they will be different, right?**
    Yes, absolutely. This was just to illustrate that for a country of 11 million people consuming the way that they consume in a western country. They need around 230 million to have the system running. Then with an estimation approach to see how much it is in other countries.
12. **We know that there's new sorting technologies that are starting to emerge between Holy Grail, next loop and AI technologies. How do you think they fit within this sorting infrastructure and when do you think they'll make a positive impact?**
    All these innovations are going to help on improving the sorting and the efficiency of the recycling. But in the current context we still need to optimize Mars' packaging, helping the efficiency of the infrastructure rather than making more complex packaging to be well sorted. Still the combination of material, it's very important.
13. **Do you have a wider view of the EU region?**
    The challenge with sorting is that it is specific in every country and even in the same country the sorting centers might operate in different way. But basically, what I want to share is the technologies that we use. But we don't have a detailed blueprint of the sorting centers.
14. **Are there any good design samples that could share to other regions? A Central SharePoint will be nice to communicate.**
    Yes. We'll talk about design guidelines in the next sessions.
15. **If complex paper packaging is a challenge for paper recycling waste streams and we see advantages in Chemical advanced recycling, are we evaluating Mars strategy here at program?**
    There is still a path on the complex paper. The point is that we really need to design it with the right combination of material. And by the moment that there is a consumer need to have some of our packaging portfolio and paper, we are still open on considering it as an option.
16. **For Chemical advanced Recycling, you shared that Mars have partnered with petrochemical companies. How can we learn more on the partnerships? How can we explore use of materials via them in test and learn capacity?**
    This is a very good question. Our partnerships today are mainly on securing recycled material from them and we can put you in contact with the buyer, Barnaby Wallace for any questions that you might have. But our main partnerships today are to secure recycled material.

Date of Waste Management Video (Module 1 of D4CG Training Modules): May 10th 2022