Efficient Collection System as a Precondition for High Quality Recycling

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Good afternoon, everyone. First of all, I would like to thank the organization for inviting us to this summit on circular economy and deposit systems. During my presentation, I'm going to talk about the efficient collection system—this is the title—as a precondition for high-quality recycling. An efficient collection system is one that manages to collect the greatest quantity of material with the minimum number of impurities. And high quality recycling that allows the realization of new products with equal or greater added value than the original from the industrial recycler's point of view. We explain this with PET beverage containers and the way in which they are recovered in Spain and other countries in Europe. If possible, I'll arrive at the bottle-to-bottle model. Europe is faced with the urgent challenge of abandoning its current linear economic model of production and consumption for a real circular economy. Europe has given us the circular economy package to implement this model.

Let's start. My name is Antonio Rearte. I have a bachelor of chemical sciences from the University of the Basque Country in the North of Spain, specializing in macromolecular chemistry and plastics. I am currently the managing director at IPARPLAST SL company, where I provide technical advise to industrial companies regarding water pollution, waste process optimization, and raw materials quality. For 15 years, I've also been the CEO at a company called IPARPET Recycling, a company specialized in the mechanical recycling of PET bottles. I'm also founder and president of the Spanish Association of PET Plastic Recyclers (ASERPET), as well as founder and technical director at RECIRCULA.

How can we get value for the packaged beverages that end up in waste management systems? It can be done if a system such as DRS is implemented, where resources—not wastes—are generated. Let me show you an example of this. So we produce a bottle. We then sell this bottle in retail stores, and then recover it via a DRS system. The material collected is high-quality, and can be used as a raw material in the production of new bottles. But first it must be recycled in a mechanical plant facility. This step is critical. Depending on the material, it can be reused and/or recycled to produce another new product. This cycle is an example of circular economy. At Recircula, our leitmotif is that no waste is left to be incinerated or deposited in a landfill. And we have our mission: to contribute to the acceleration of the change of the linear economy towards a circular economy model. An essential part of moving towards a "waste to resource" model is changing the collection system.

This is the actual situation in Spain. This material, this is waste. It's not a business opportunity. This is the Green Dot, the curbside collection system. And this is the future, this is the DRS system. This is the high quality raw material. We have different collection system types in Spain: curbside collection, underground containers, pneumatic systems, clean points fixed or mobile, door-to-door (very selective), and, finally, DRS. There are big differences between the systems. Yes, all of the systems are aimed at collecting end-of-life material and recovering some value from that material.

These slides show how performance results vary depending on the collection system. In a DRS system, 85% of plastic beverage containers are collected and recovered. In a curbside collection and recovery system, the number is less than 30%. And, finally, landfill collection (collected directly from the landfill): less than 10% of total plastic beverage containers are collected. These figures represent the situation in Spain, and are from Miteco. Miteco is Spain's Ministry of Environment, and they analyze the different collection systems based on their levels of performance and/or quantity of contaminants. According to Miteco, the best collection system is door-to-door, because it has achieves a very, very high level of

performance, with a very, very low, contamination rate. But, in Spain, we still don't have a DRS system, and DRS is the system that achieves the highest performance with highest quality of material.

This is a picture of a man returning a bottle in a little region called Navarra in the North of Spain. Navarra is an environmentally conscious region, and has a new waste law. From 5 July to 31 October 2018, in this region, we ran a pilot project that proved to be very successful. We placed two RVMs in Urbasa and Alloz campings and collected nearly 65,000 (more than 1 ton) containers in two months. According to Navarra's Government, the quality of the material is much, much better (0% contamination in the DRS system compared to 21.7% in Navarra's sorting plants). This is the future, not only in Navarra but in Spain, too.

The picture in this next slide shows two different system flows: one for PET bottle containers that come from the landfill or are collected via curbside systems (line #1), and the other for PET bottles recovered via DRS systems (line #2). Let's first look at line #1. We treat this material in a mechanical recycling PET industrial processing. The yield for this system is only 50%; the other 50% is waste. If we now look at line #2, the PET bottles that are collected via a DRS system undergo a mechanical recycling process too but the yield is at least 85%, and the amount going to waste (which is very important) is less than 6%. The final product we get is pellets, which can be used in bottle-to-bottle applications (something of same value as the original). This is a clear example of circular economy; prevention, recycling, and reuse. In line #1, the final product we get from the recycling process is PET flakes, which are used in lower-end applications like fibers and straps. This material goes directly to the linear economy, and eventually to the landfill. This is the reality in a lot of European countries that don't have a DRS system. We have to do something to change this. But what happen if the material that obtain with any system is possible to doing a industrial process with success? All material goes directly to the landfill again. This is a very, very important thing. I think that Gintaras showed us a video of what happens after material goes through the counting centre facilities, and what happens after the sorting centre in line#1: Landfill. A bit later, I will show you with a figure that this is the result of two different situations. The system flow showed in line #1 is still the reality for a lot of European countries. And the DRS system is an opportunity for the future of all materials, not only for PET beverage containers, but also for cans and other types of containers.

Let's now talk about the environmental impacts of the mechanical recycling process, depending on the origin of the material to be treated (landfill material, curbside collection material, and DRS material). It is clear from this table which collection system makes the most sense from an economic and environmental point of view. Here you can see the industrial operative yield of each system: 37% for landfill material, 52% for kerbside material, and 93% for DRS material. The next line in this table is also very important: material sent to landfill. A system that results in 49% or 60% of material going to landfill – this is unacceptable. As you can see, the total level of impurities is very high in the case of material collected from kerbside systems or from landfill, while the material coming from the DRS system has close to zero impurities and a very acceptable yield.

The next slide shows various parameters of water contamination depending on the origin of the material to be treated. The parameters we have compared here are pH, conductivity (us/cm), solids in suspension (mg/L), COD (mg/L), and fresh water consumption, the latter of which is very important. In the case of recycling PET bottles coming from landfill, 32L of water is used per kg of PET processed. For material that was collected in the kerbside system, 12L of water is consumed per kg of PET processed, and for DRS material, the number is 5L. From these figures, I think it doesn't make sense to recycle these

materials at all (kerbside and landfill material). We're buying this material and 7% goes directly to the landfill. Why? This is not sustainable, and neither is curbside collection. In Spain, the landfills are full of these bottles. Why? Because we don't have a system that recovers these bottles; we don't have a DRS system.

Moving on to air pollution. In this table, we can see how depending on the collection system and where the material comes from, the amount of CO2 emissions varies widely. Compared to landfill material or material collected curbside, the level of CO2 emissions associated with DRS material is reduced by 30%. The Bilan Carbone method was used to estimate the greenhouse gas emissions generated by all the physical processes (transport, energy, etc) and materials involved in the mechanical recycling of PET bottles. These are the results. If we implement DRS, we have less greenhouse effect. If, on the other hand, we continue with the current Government-managed model, we will have greater air pollution and greenhouse effect.

When we look at the quality of the materials recovered, there is also an enormous difference between the linear and circular economy, as you can see in this picture. One of the parameters of great technical importance in PET bottle recycling is the intrinsic viscosity of the PET flakes. The viscosity is a direct consequence of the impurity content of the starting material. For material that was collected via curbside, the viscosity is 0.62 dl/g; for landfill material it is 0.60 dl/g; and for DRS material it is 0.78 dl/g. Why does this matter? Because with these values, it is possible that the material coming from curbside collection or landfill is not high-quality enough to be utilized in the recycling process. And then, why recycle? In the last five years, this parameter—the viscosity—has decreased from 0.8, 0.82 to 0.62 and 0.6. For material that is collected via curbside collection, we do thermoform extrusion, fibers, straps, etc., and remember, all of this is downcycling. With landfill material, the situation is worse: colour thermoform extrusion, fibers, straps. Again, all of these applications are downcycling. With DRS material, we can do injection and bottle-to-bottle recycling, which is upcycling. This is the target. The rest we don't care about.

So what are our main conclusions? There is a lack of supply of high-quality materials, and quality is the biggest problem for the use of recycled materials as raw material. Almost 60% of European plastic processing companies find it difficult or very difficult to obtain recycled plastics with an acceptable quality, and only 27% declare that their customers are sufficiently aware of the benefits and needs of using recycling plastic material. Also interesting is that almost 60% of the European plastic processing companies think that current regulations are not adequate to support a greater use of recycling plastic material in the future.

In Spain, six companies gave up plastic recycling after two years due to low profitability. The article says that "it's an aberration in terms of sustainability that recyclers have to return material to landfill; the cost of transporting waste is extremely high and has a negative impact on our operation." It goes on to say that recyclers have "complained but have no choice; we have to continue buying waste because they are a monopoly in Spain." The amount of recyclables going to waste is enormous; nearly 50% of the material goes to the landfill. This the reality in Spain, Portugal, France, Italy.

Here is an article about the situation in China. Historically, China has received 35% of Spain's plastics sent for recycling, but since 2018, China no longer buys foreign garbage. This means that the situation is Spain is now worse. The Spanish Federation of Recovery and Recycling has stated that there will be negative consequences for not only Spain, but for all countries in Europe.

The next slide shows an economic comparison of the value of PET bales over time, from DRS, RSU, and kerbside collection. This is the main difference between the systems: quality of the recyclables. How much does the material cost for the recycler?

Here are my main conclusions about DRS systems. The main and most important thing is that DRS increases the final product quality, so that wastes can become resources, and so that upcycling can occur, increasing the circularity index and promoting prevention and reuse. DRS systems provide sustainable and good quality materials having a very low environmental impact in terms of water pollution or GHG emissions. DRS is a system integrated in a real circular economy, and is economically and environmentally sustainable. We have to change the model in Spain from the current curbside system to the deposit system if we want to at least achieve European targets. Materials that come directly from landfills only facilitate commercial speculation and their recycling becomes so complex that the environmental impact is unsustainable. Curbside collection systems promote linearity with almost no circularity index, and do not avoid the manufacture of new containers. Recycling, yes, but not at any price. Sustainable recycling is the solution. The final solution has a name: DRS system. Thank you for your attention.