

## 1 INTRODUCTION

In a global and national context of growing environmental awareness, plastics are being integrated into a circular economy as a paradigm of a sustainable future. This new production and consumption model seeks to reduce waste, make more rational use of resources and take care of the environment. Thus, plastics would never become waste, being incorporated into closed cycles. According to a study by the UN Environment (United Nations Organization), a circular economy could reduce industrial waste by between 80% and 99% in some sectors and between 79% and 99% of its emissions<sup>3,3</sup>.

The circular economy is an economic concept that is closely interrelated with sustainability, and whose objective is that materials, products and natural resources remain in the economy for as long as possible, reducing the generation of waste.

The objective of the circular economy is to provide a better economic and environmental system, by creating and rethinking an efficient use of material when it reaches the end of its useful life, accompanied by the contribution of innovation and technologies.

The principle of the circular economy is inspired by nature, where there is no concept of waste: everything that nature generates is an input or food for another organism. It's a

Consequently, the circular economy is a more sustainable and alternative model to the traditional linear economy. The linear model follows the route of extracting resources, manufacturing, using and discarding. In contrast, in a circular economy, resources are used for as long as possible, maximum value is extracted from them while they are in use, and then products and materials are recovered and regenerated at the end of their useful life. As a result, a circular economy also means a way to improve the competitiveness and efficiency of available resources.

### 1.1 Principles Of the circular economy

The Ellen MacArthur Foundation, UK, in Towards a Circular Economy report, from the United Kingdom, in the report Towards a Circular Economy report<sup>3,14</sup>, states that the circular economy is based on three key principles:

1. Preserve and enhance natural capital, controlling finite reserves and balancing the flows of renewable resources.
2. Optimize the performance of resources, distributing products, components and materials with their maximum utility.
3. Promote the efficiency of the systems, detecting and eliminating negative external factors from the design.

The principles described above act as principles of action. Furthermore, a circular economy is defined from the following key



Figure 1. Linear economy Vs Circular economy

closed flow in which everything flows.

features:

- Recycling: The waste becomes a resource. All biodegradable material returns to nature and that which is not biodegradable is re-manufactured.
- Reduction: It refers to rationalizing the amount of plastic products consumed and the production of virgin materials.
- Reuse: It is to repeat the use of an object, as many times as possible before destroying or discarding it, and with it, reducing energy consumption and the impact that its manufacture represents on the environment.
- Ecological design: In order to keep the goods within the system for as long as possible, companies must favor eco-conception, which considers environmental impacts throughout the life cycle of a product and integrates them from its conception.
- Repair: It is about finding a second life to the products for which their useful life ends.  
MacArthur<sup>7,15</sup>,
- Appreciation. It consists of making energy use of waste that cannot be recycled.
- Economy of functionality: Sustainable development requires the sale of eco-friendly services and not simply disposable goods, with great impact on the environment.
- Use of renewable energy: With this, the consumption of fossil fuels is eliminated, with the use of alternative energy sources.
- Systematic perspective: Look for an approach in which each part of the system is connected to each other. This encourages practices that can benefit consumer chains and the environment, associated with the manufacture of goods.

## 1.2 Benefits

The principles of the circular economy could provide environmental, social and economic benefits. Of its innumerable benefits, the

reduction in the use of resources, the reduction of waste production and the limitation of energy consumption stand out. For companies, reusing resources is more profitable than creating them from scratch. Consequently, the prices of production are reduced, as well as the price of the final product, also benefiting the consumer.

The implementation of this new paradigm guarantees a better supply of raw materials, gradually reducing imports and external dependence. In addition, the circular economy could generate new markets, such as the production of compost or the growth of the recycling industry. A study by the consulting firm McKinsey & Company for the Ellen MacArthur Foundation<sup>3,14</sup>, exposes that if the circular economy is applied only to the manufacturing sector, about 625,000 million euros would be saved and tens of thousands of jobs would be created.

In the environmental aspect, the extraction of natural resources and greenhouse gas emissions would be reduced, limiting environmental impacts. A study by the Ellen MacArthur and McKinsey Foundation Internal Growth: *A Circular Economy Vision for a Competitive Europe*<sup>3,15</sup> recognizes that carbon dioxide emissions would be reduced by 48% by 2030 and 83% by 2050.

## ▪ 2 PLASTICS, PART OF THE SOLUTION

A study carried out by the company Ecoplas, *Environmental impact of the substitution of plastic containers on energy consumption and greenhouse gas emissions in the United States and Canada*<sup>3,10</sup>, shows that plastic packaging is an effective choice in terms of energy savings and impacts on global warming. In addition, its replacement by other packaging of alternative materials would generate 130% more gas emissions with an effect on global warming, an increase in energy of more than 80% and an increase in the final weight of urban solid waste of 4.5 times.

# Technical Bulletin: The circular economy in the plastics sector

The characteristics of plastics allow it to play an important role in the path to a more sustainable and resource efficient future.

## a) Controls the release of carbon:

Plastic is an ecological material thanks to its recyclability. In fact, its slow degradation is beneficial, because the longer this natural process takes to take place, the longer it takes for carbon - its main component - to be released into the chain of greenhouse gas formation.

## b) Sustainable processing:

Compared to other materials, such as glass, cement or metals, plastics require very low amounts of energy to process, due to their lower melting point and low thermal capacity. Due to their characteristics - light, versatile and durable - plastics help to save essential resources such as energy and water in strategic processes such as packaging, building, construction, transportation, among others. In addition, plastic applications in packaging contribute to reducing food waste due to its excellent barrier properties.

## c) They can be recovered and transformed into new products:

At the end of their useful life, plastic products are recovered and transformed into resources for recycling, returning to the circuit as new products. This circular flow means greater

resource and energy efficiency, reduced waste, and the sustainability of the plastic recycling industry.

Figure 2 shows the cycle of plastic, from its production, passing to its responsible consumption, separation in homes, the contribution of urban reclaimers for packaging and marketing to the recycling industry. This industry processes it to obtain a new recycled plastic raw material that is transformed into new final products. It can also be transformed into energy, through the energy recovery process, or recovered through chemical recycling.

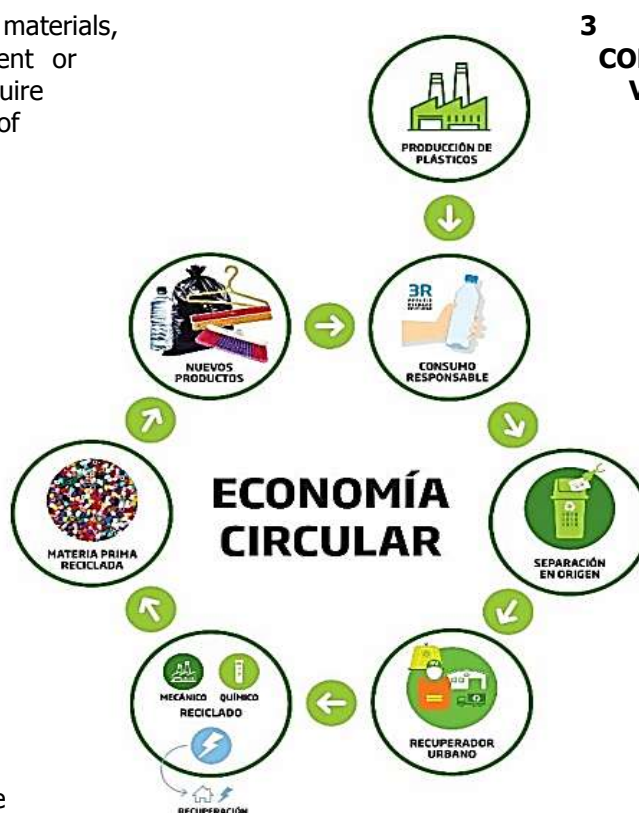


Figure 2. Circular economy of plastic

## 3 PROCESSES OF CONSERVATION OF VALUE (PCV)

According to the UN Environment report, Redefining Value: *The Manufacturing Revolution*<sup>3,3</sup>, the conservation of value (PCV) processes, such as remanufacturing, renovation, repair and direct reuse, and recycling are complementary processes that, if carried out strategically, can accelerate the achievement of the circular economy, allowing the creation of a new value for both the producer and the customer, with a reduced

environmental impact.

Although many actors in the supply chain in manufacturing are currently focused on recycling their products, the adoption of PCV can lead to the preservation of substantially greater value in the system: PCVs allow the inherent value of the product to be preserved, while that recycling conserves only

the value of the material or resource being recycled.

Remanufacturing and refurbishment or reconditioning are standardized and intensive industrial processes that provide the opportunity to add value and utility to the useful life of a product. These processes produce like-new (remanufacture) and high-quality (comprehensive overhaul) products, with significantly less environmental impact and lower cost to the manufacturer and possibly the customer.

Repair and reuse are formal and informal maintenance processes that offer the opportunity to extend the useful life of the product, generating a significantly lower environmental impact and a lower cost for the manufacturer and, possibly, for the customer.

## 1.2 Post consumer recycled

Recycled Post Consumption (PCR) refers to plastics recycled from domestic, industrial, commercial and agricultural post-consumer plastic waste that, through a transformation process, become plastic raw material that is used to produce new end-use products. .

There are two types of recycling processes: mechanical and chemical<sup>[1]</sup>. The first of them is also known as physical recycling, because the plastic is melted and reprocessed to form a new component that may or may not be of the same type as the original part. On the other hand, chemical recycling is a process in which the object to be recycled is returned to its primary components, such as gasoline and hydrocarbons for polyolefins and monomers in polyesters and polyamides; These components can later be used as raw material for a new polymer production.

In the global environment, innovations are being developed that promote the circularity of plastics. The Sabic company in conjunction with Plastic Energy, announced the production and commercialization of "certified circular polymers" using raw material obtained from mixed plastic waste

(polyethylene and polypropylene), prior to the start-up of the plants for 2021<sup>3,16</sup>.

The **Braskem Idesa** company will launch to the Mexican and export markets, a new high-density polyethylene resin with Post-Consumer content, to market up to 25 thousand tons of recycled HDPE, destined for rigid applications that require high chemical resistance. Under the motto *Nothing is created, nothing is wasted and everything is converted*, by 2040 Braskem Idesa aspires that 100% of plastic packaging will be reused, recycled or recovered<sup>3,4</sup>.

Another similar case is the company **Borealis**, which in its contribution to the circular economy, developed a 100% recycled, regranulated and high-quality PE, which has been used to pack the Henkel company's made-at-home glues<sup>3,2</sup>. Similarly, **Borealis** introduced a new plastic recycling technology, *Borcycle*. This technology will be used to produce high quality recycled polyolefin compounds with more than 80% recycled content for application to visible parts of household appliances.

The ARQLITE company manufactured plastic stones made with 100% recycled material that admits a mixture of different plastic materials (HDPE, LDPE, PS, PP, PET). A lightweight concrete is obtained that replaces the pebble in its manufacture and improves thermal insulation. In addition, the exploitation of pebble quarries and their transport are avoided. As a result, lighter structures are achieved.



Figure 3. Plastic stone

The company **EWAR, S. A.** produces plastic wood using recycled polyethylene, polypropylene and rice husk material. It is a 100% recycled product, resistant to the elements, which does not succumb to mold or rain damage. It is resistant to solar action, it is not affected by the marine environment and it does not crack. It is free of maintenance and paints with a duration of 50 years. This product prevents the felling of trees.



Figure 4. Plastic wood

The **ACA** company uses recycled polyethylene in the form of pellets from waste silos, bags and phytosanitary products, which are used extensively in agricultural areas. The product is 100% recycled and is used to produce a wide variety of end products: pipes, protective tubes for communication cables (optical fibers), consortium bags, buckets, flowerpots, furniture for squares and schools. The same product made with recycling saves 89% energy and reduces 67% of greenhouse gases, avoiding global warming.



Figure 5. Recycled polyethylene silo bags

## 1.2 Ecodesign

According to the Ellen MacArthur Foundation, a circular economy is one that is restorative and regenerative by design<sup>3,18</sup>. Ecodesign is an instrument to generate quality products and services, respectful of the environment and socially responsible. Ecodesign takes into account aesthetics and their function, in addition to assessing all elements of the production and distribution chain.

For example, in the manufacture of containers and packaging, new products have been designed that allow the value and functionality of the base resin to be maintained. The manufacturer Illig, under the *Design4Recycling* concept, presented a labeling technology at the K2019 Fair, which combines in-mold decoration technology with a cardboard label. The packaging has a thin plastic internal coating and the cardboard is the one that is intervened for decoration, without using adhesive.

The new labeling technology preserves the conditions of the product and avoids its contamination even before reaching the consumer (due to the amount of inks with which they are printed or adhesives used on the labels). It also allows the raw material to maintain its properties, so that when using it again its value is not lost, but can be used in an article with the same benefits.<sup>3,13</sup>



Figure 6. Packaging labeling design

In addition, the Dow Company introduced a variety of products to help brand owners and converters achieve their recyclability goals with polyethylene (PE) packaging. These

products designed for recycling feature different food packaging, household and personal care applications using the company's resins, coatings and adhesives.<sup>3,17</sup>



Figure 7. Recyclable packaging

**Dow** introduces concepts for simple barrier-free multilayer structures, more complex packaging with customized food barrier, and redesign of the conversion process, including the use of compatibilizers to help improve the mechanical recyclability of multilayer packaging, and a insertion of nozzles. Polyethylene-based solutions have been developed for thermoformed bags and packaging.



Figure 8. Recyclable packaging

## 2. WORLD ORGANIZATIONS IN FAVOR OF THE CIRCULAR ECONOMY

At the global level, various foundations have been developed to give a positive vision of the circular economy for plastics. **The Ellen MacArthur Foundation** is the leading independent advocate for the circular economy, bringing businesses and

governments together behind a positive vision of a circular economy for plastics. Among the main global companies that the Ellen MacArthur Foundation brings together are: Borealis, Nestlé, WalMart, Danone, Google, H&M Group, Philips, Renault, SC Johnson, Solvay and Unilever.

**The New Plastics Economy**, for its part, it is an initiative of the Ellen MacArthur Foundation that focuses on creating a shared sense of direction, by all stakeholders, promoting actions and innovations to move towards a circular economy where plastics never become waste. This initiative is supported by three key actions: eliminate, innovate, circulate<sup>3,19</sup>.

The systematic approach is based on five interconnected elements:

1. Mechanism of dialogue. It is an advisory board that enables value chain collaboration to solve challenges. It includes global consumer goods companies, retailers, packaging manufacturers and plastics producers, working in conjunction with companies involved in collecting, sorting and reprocessing, to drive collaborative projects and shape the initiative.
2. Global commitment. It aims to address plastic waste and pollution at its source. Allows you to align stakeholders with a common vision and a set of specific objectives. Likewise, more than 400 organizations have joined the global commitment, representing 20% of all plastic packaging produced worldwide to address the plastic waste crisis<sup>3,7</sup>.
3. The plastic pact. It is a network of initiatives that unites governments, companies and citizens with a common vision and specific objectives to implement solutions towards a circular economy for plastics<sup>3,8</sup>.
4. Innovation. It focuses on continuously developing the knowledge that allows

meeting the objectives of a circular economy for plastics.

5. Cope and stakeholder participation. Engage with key stakeholders to learn, inform and scale up actions.

Likewise, countries such as France, the United Kingdom and Chile have joined this organization, which is set to meet four key objectives in the plastic sector by 2025, essentially in the packaging sector<sup>3,9</sup>. These are:

- 100% of the plastic containers will be reusable, recyclable or compostable.
- 70% of plastic packaging is recycled or composted effectively
- Eliminate single-use packaging, through redesign, innovation or alternative delivery models (reuse).
- Plastic containers and packaging must have, on average, 30% recycled material..

The Mexican industry, for its part, set five goals in which the resin industry will work to move towards a circular economy<sup>3,20</sup>. These goals are:

- Reduction and elimination of pellets in the process and transport stages of all its products.
- Establishment of eco-design criteria in distribution materials, so that packaging and containers are more easily reusable and / or recyclable at the end of their life cycle.
- Expand the participation of activities related to material handling plans, at the end of their life cycle.
- Modify the characteristics and properties of raw materials, which allows the use of post-consumer materials without affecting their fine functionality.
- Strengthen participation in education programs to minimize waste generation.

## 2 CIRCULAR ECONOMY IN VENEZUELA

In Venezuela, reality imposes the need to start innovating in this type of economy, mainly due to the costs associated with the production and acquisition of new products. Although there is a lack of public policies and articulation of the State with private companies, there are initiatives that show interest in reducing, reusing and recycling materials and caring for the planet.

Thus, for example, various environmental foundations promote recycling programs, to create environmental awareness and reduce the amount of garbage directed to landfills.

**Nestlé Venezuela**, for its part, is committed to achieving a waste-free future, allying with **Multirecicla**, a Venezuelan company focused on the recovery, classification and storage of recyclable material. This alliance will develop activities to continue promoting concrete and sustainable actions of awareness, training, collection, recycling and correct disposal of plastic waste.

At the beginning of the year, Nestlé made a commitment to ensure, by 2025, that its product packaging is 100% recyclable or reusable and that none of it ends up in landfills or garbage. In that sense, Nestlé's approach is centered on three core areas of work: developing packaging for the future that is respectful of the environment, helping to shape a future free of waste and driving new behavior and understanding about the use, reuse and recycling of packaging.

In recent years, several private and voluntary initiatives have emerged, which reveal that recycling arouses interest in the Venezuelan population. **Green corners**, from the telecommunications company Movistar and **Tapas for life**, a movement promoted by university students, are proof of this.

## 3 SUMMARY AND CONCLUSIONS

Plastic is a noble, innocuous and recyclable material that can also be used as an

alternative energy source, given its high heat capacity.

The world is heading towards a circular economy, where all materials, not just plastic, can be converted into other products. For this, the participation of Governments, Non-Governmental Organizations and communities is necessary to promote sustainable habits. It is also essential to implement citizen education for the responsible and rational use of plastics and their correct final disposal. Governments should be responsible for conducting communication, education and awareness campaigns for the revaluation of materials. However, the campaigns are not enough if they are not accompanied by waste management policies and recycling infrastructures that allow the differentiated collection of recyclable materials, in addition to legislation that defends the circulation of recycled products.

Many leading companies around the world are betting on the innovation of their plastic designs and are pursuing alternatives for recycling and reusing their products, adaptable to the market.

The circular economy, in addition to making a significant contribution to the environment, is also an opportunity for economic and social growth for countries. It is worth rethinking how to manufacture industrial products that, at the end of their useful life, can provide innovative environmental, social and economic benefits.

## Where to start?

- Implement Ecodesign strategies.
- Develop systems to improve the collection, classification and reprocessing of materials.
- Work on innovation and processing technologies.
- Develop the market for products made with recycled plastic.
- Maintain focus on key innovation opportunities that have the potential to expand, such as investment in

improvements or new materials and reprocessing technologies.

- Implement public policies that accompany the development of the circular economy.
- Carry out training campaigns for responsible consumption and separation of waste.

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