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Paving the Sustainability Journey:

Flexible Packaging Between Circular Economy and Resource Efficiency

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ABSTRACT

Sustainability is the ability to continue a defined behavior indefinitely, therefore not hindering the future in any way, neither environmental, nor economic or social. The entire scientific community around the world recognizes and attributes the main cause of climate change and temperature anomaly to the significant increase of anthropogenic CO2 emissions, which in turn are the result of a linear economy of production, consumption and disposal. By 2030 the EU expects all packaging to be either recyclable or reusable. In this context, flexible packaging, always hailed as a sustainable and resource-efficient alternative to rigid packaging, is now being challenged, in terms of its recyclability and its preponderant role in pollution of seas and oceans. To avoid litter, leakage and marine pollution, flexibles must be collected within a recognized waste stream, and strictly kept out of general, undifferentiated garbage. GualapackGroup therefore promotes and advocates the collection of all packaging, and specifically the flexible plastic fraction of household waste. GualapackGroup is actively working to improve the recyclability of its packaging solutions and is at an advanced stage of prototyping and developing its first monomaterial, recyclable spouted pouch

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INTRODUCTION

Sustainability is a journey, not a final destination. It is the ability to continue a defined behavior indefinitely, therefore not hindering the future in any way, neither environmental, nor economic or social. Every sector of industry and society is actively seeking 'perfect fit' sustainability solutions, and the packaging world is no exception.

TWO FACES OF A COIN: CLIMATE CHANGE AND A LINEAR ECONOMY

Climate change by definition is not sustainable, as it cannot continue indefinitely without consequences. In the last 100 years, the Earth's average surface temperature has increased by about 0.8°C, with about two thirds of the increase occurring over just the last three decades. The unprecedented increase in the average global temperature anomaly of the last 30 years will have extreme consequences, and become irreversible, if it surpasses the +2°C mark.

According to a study published in Nature Climate Change [2], for 2°C of warming the fraction of precipitation extremes attributable to human influence rises to about 40%. Likewise, today about 75% of the moderate daily hot extremes over land are attributable to global warming. It is the most rare and extreme events for which the largest fraction is anthropogenic, and that contribution increases non-linearly with further warming.

Sustained global warming of more than 2°C (relative to pre-industrial levels) could lead to eventual sea level rise of around 1 to 4m due to thermal expansion of sea water and the melting of glaciers and small ice caps. Warming beyond the 2°C target would potentially lead to rates of sea-level rise dominated by ice loss from Antarctica. Continued CO2 emissions over the next millennia would ultimately eliminate the entire Antarctic ice sheet, causing about 58m of sea level rise.

Changes in regional climate are expected to include greater warming at high northern latitudes, and more frequent and severe episodes of extreme weather, such as hurricanes, tropical cyclones, tsunamis, heat waves and droughts. [3]

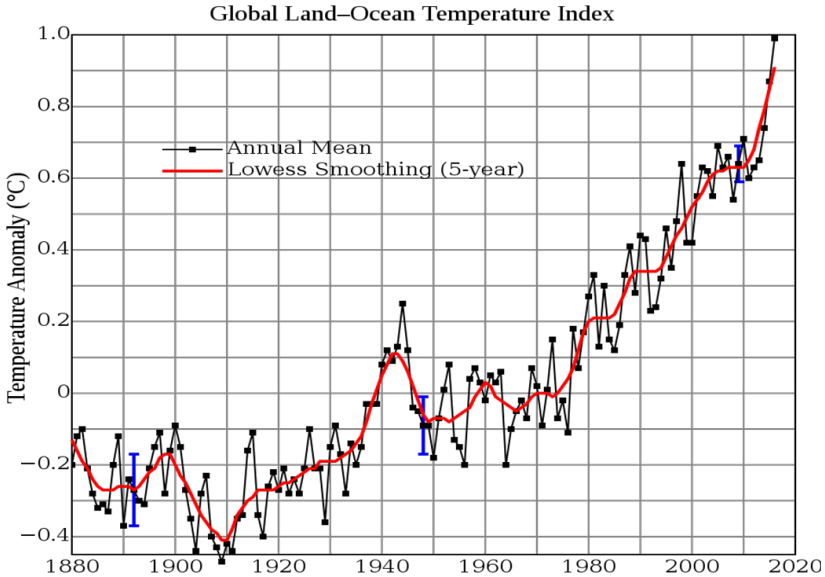

Figure 1. Graph recording the increase in temperature anomaly (°C) from 1880 to 2020. [1]

The entire scientific community around the world recognizes and attributes the main cause of such climate change and temperature anomaly to the significant increase of anthropogenic CO2 emissions, which in turn are the result of any human process, from breathing to fossil fuel-based energy or heat, from intensive agriculture and livestock, to production, manufacturing and disposal of household goods.

Therefore, a significant amount of anthropogenic CO2 emissions is directly related to what is defined as Linear Economy, based on the principle of continued mass production and consequent disposal of goods, without which the economy would not be able to thrive. In a linear economy, reuse or repair of an object is contrary to a renewed purchase and in this sense, is a direct loss. Sometimes, it is easier and less environmentally impacting, to dispose of a good rather than make an effort to recycle it, when this proves to be challenge. It depends on which materials it is made of, what is customary in local culture, and of course, on how much energy is used to put recover, reuse or repair the given object. That is why, the total CO2 emissions associated to the existence of an entity must include everything, from the raw materials sourced, to its end of life: this is also known as the Carbon Footprint of the entity and is one of the main environmental impact parameters taken into account, along with water consumption, eutrophication and others, when carrying out a Life Cycle Analysis (LCA).

By Circular Economy, instead, we define a system that is restorative and regenerative by design. [4] In a circular economy, a society should source its raw materials in a way that is environmentally, socially and economically sustainable, i.e. not from petroleum; then it should design its products adhering to principles of recovery and reuse, building recyclability and sustainability into the design. In a circular economy, society should not only stop at the specific functionality of a product during its application period, which often is several orders of magnitude shorter than the total lifespan of the item in the environment.

In a perfect circular economy, there would be no need to deplete any virgin resources at all, as the same raw materials would be constantly recycled and put back into the value chain indefinitely. We must note that a true circular economy is therefore very different from "postponed waste", that is, recycling one object into another object, that will in turn accumulate as waste. For example, a PET bottle that is recycled into polyester fiber to make a pile jacket, is today's typical way to avoid the bottle going to landfill, and is heralded as the example of a virtuous circle. However, there cannot be an endless number of pile jackets and eventually the clothing will in turn become a form of secondary plastic waste that will need to be disposed of. In other words, the problem has only been delayed. In this scenario, a true circular economy would need to indefinitely bring all objects back to their raw material state, and sometimes mechanical recycling may not be enough, and other chemical transformations may be required.

It is crucial, however, to make sure that in the achievement of such an effort, the amount of energy and CO2 emissions generated to recover and remake, are not higher than those associated to production ex novo, as well as the consumption of fresh water, use of nitrogen and other negative environmental impact factors. Hence the fundamental importance of a solid and universal LCA methodology, where cradle-to-grave and cradle-to-cradle scenarios for any product can be holistically and critically compared for making the best case-by-case choice between a linear, an intermediate, and a completely circular approach.

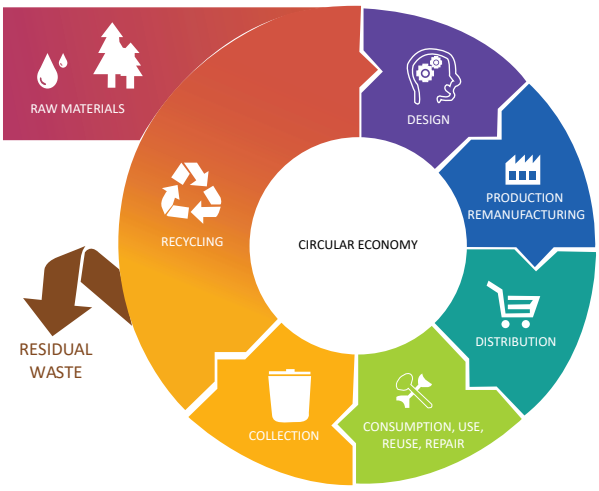

Figure 2. Illustrated Diagram of a Circular Economy [4]

IN THE CROSSFIRE: FLEXIBLE PACKAGING TODAY

To succeed and prosper over time, the packaging industry cannot forego the principles of sustainability and circular economy.

Recently, the European Plastics Strategy and specifically via its Waste Packaging Directive, has given high priority to improvement of recyclability and reuse of plastics, especially plastic packaging. By 2030 the EU expects all packaging to be either recyclable or reusable. Energy as a form of recovery is not seen as a preferred option anymore, and the target of drastically reducing and eventually eliminating landfill must therefore be achieved through waste collection and recycling. [5] This ambitious

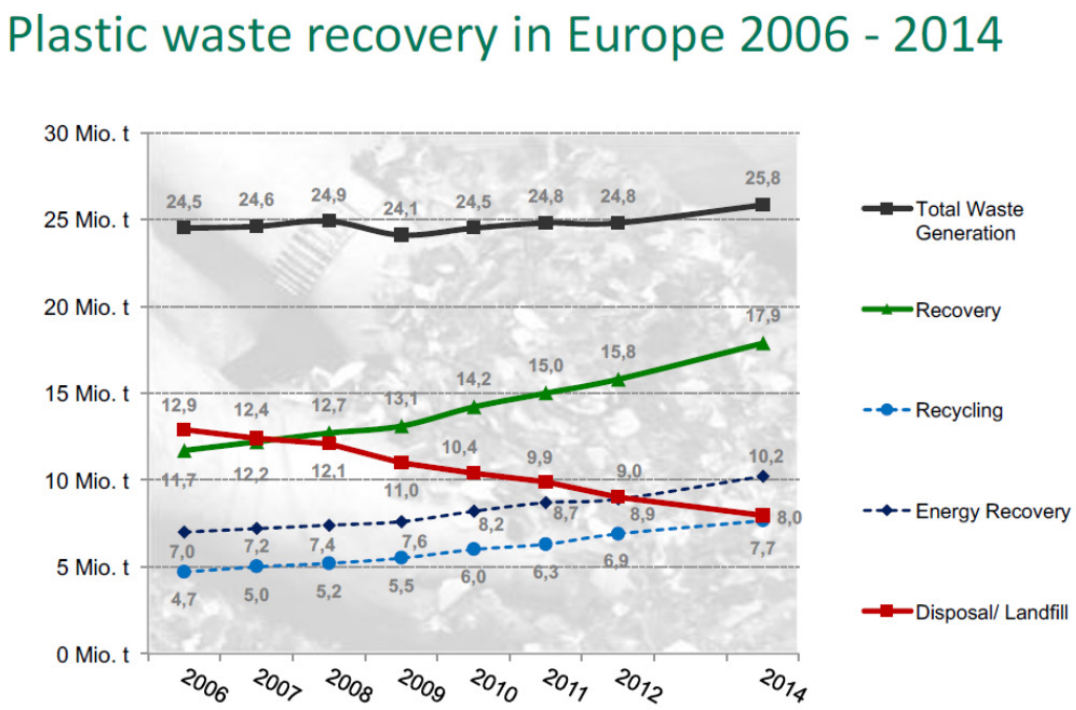

Figure 3: Plastic Waste Recovery in the EU from 2006 to 2014 [7]

commitment is especially related to the great emergency of marine litter, which has exploded as a mainstream topic. The media have given high resonance to this ecological disaster, conveying messages that are fact-based but sometimes partial, communicated with too much emotion and not pragmatically approached.

Several of the leading brand owners and retailers have voluntarily pledged that by 2025 their packaging must become 100% recyclable, reusable, or compostable. Also, they have coherently taken the commitment of putting higher percentages of post-consumer recycled materials in their final product. [6]

In this context, flexible packaging, always hailed as a sustainable and resource-efficient alternative to rigid, frangible, or heavy packaging, is now being challenged, in terms of its recyclability and its preponderant role in the pollution of rivers, beaches and major bodies of water. Flexible packaging in fact, today is not collected in most geographies, because of its typically non-homogeneous nature, in terms of color, inks, polymer chemistry, and structure. Also, its low density makes it less economically viable to collect, compact, sort and pelletize for extrusion.

The Great Pacific Garbage Patch, a million-ton, plastic-based trash vortex that since the 80s has been accumulating in the North-Pacific Ocean and breaking down into smaller, more dangerous fragments, has become a dramatic cause that most global brand owners and governments have embraced and are willing to fight for. Advocacy against plastic in the oceans and consumer awareness is in fact growing exponentially.[8] The health hazard associated to microplastics and the threat posed to the ecosystem of seas and oceans has brought the topic of plastic waste leaking into the environment to become more significant, more emotionally felt, and more widely perceived, than

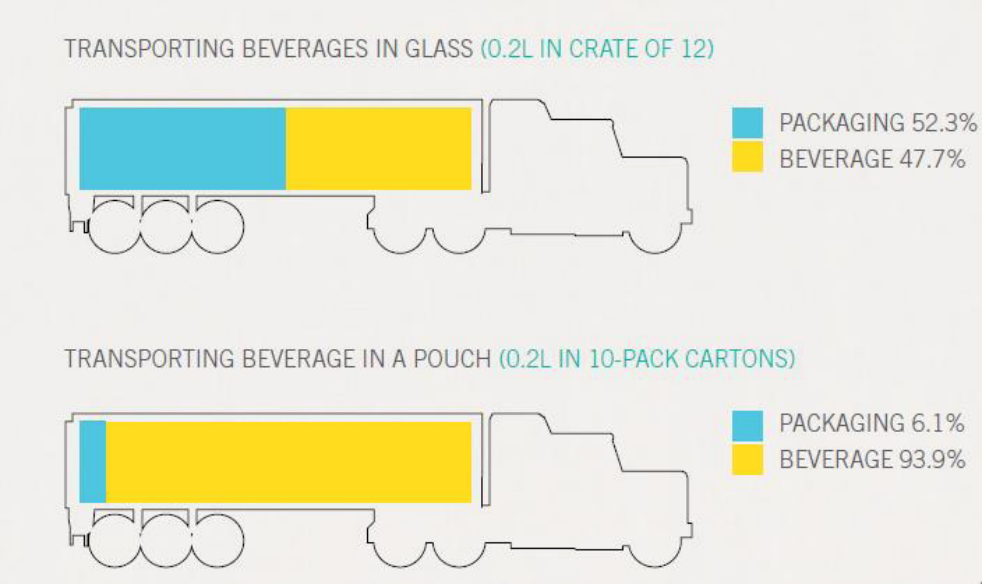

Figure 4: infographic comparison of two beverage transportation scenarios [9]

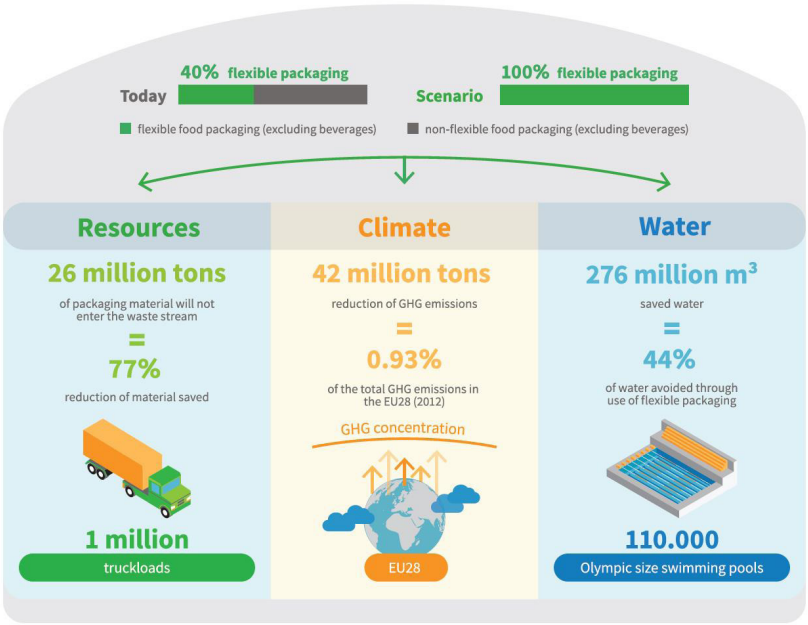

Figure 5: infographic comparison of two hypothetical scenarios of packaging [11]

the issue of global warming and climate change, the latter being however potentially much more devastating in terms of its effects on the Planet and on the future of humanity, fauna and vegetation.

Flexible packaging intrinsically is favored in fighting climate change, due to its resource efficient, lightweight format which affords a much lower carbon footprint compared to other packaging formats. For example, a well-known Study has shown that transporting 0.2L beverage glass bottles in crates as opposed to 0.2L beverage pouches in 10-pack cartons, equals to carrying only half a truck of juice by weight, the rest being mostly glass, as opposed to filling the truck with ~94 wt% juice and having only ~6 wt% packaging. [9]

The objective of lightweight packaging is being pursued also by rigid packaging sectors such as PET bottles, despite the greater technological challenge associated to achieving the required performance: a typical 500mL PET bottle in 2010 was 40% lighter than the equivalent bottle in 1994. [10] The same is seen for glass and cans, because of energy associated to extraction and transformation of the raw materials being the single largest environmental impact factor.

The IFEU (Institut für Energie-und Umweltforschung) of Heidelberg has recently updated its well-known study according to which a direct comparison of two extreme scenarios, one supposing all food packaging being 100% flexible albeit not recyclable, and the other supposing all existing non-flexible packaging being recycled at a 100% recovery rate. This hypothetical comparison highlights the resource efficiency, low environmental impact and general savings in terms of raw materials, GHG emissions and water consumption associated to the 100% flexible packaging scenario, despite it not being recycled. In fact, IFEU estimates that 77%

less materials would enter the waste stream, thereby preventing the need for their recycling in the first place, and 44% less water would be consumed in the processes both upstream and downstream, when recycling and bringing the non-flexibles back into the value chain. [11]

WHAT CAN BE IMPROVED IN THE EOL OF FLEXIBLE PACKAGING

To avoid litter, leakage and marine pollution, flexibles must be collected within a recognized waste stream, and strictly kept out of general, undifferentiated garbage.

Not only multilayer multimaterial flexible packaging, but also simple monomaterial films such as PE or PP shrink wrap around bottles, or potato chip bags, today are not being recycled in most countries around the world, because there is no infrastructure supporting their collection when they reach End Of Life. Most waste collection is organized around rigid bottles, above all clear PET, while everything else is seen as a contaminant or as an added cost. Until recently, there has been little to no demand for recycled post-consumer material to be mixed into virgin raw material for production of other goods, except for low-value, low-performance applications (water pipes, park benches, flower pots, etc.). It is necessary to create demand, by improving the quality of post-consumer recycled plastic, including flexible packaging, and thereby enable it to be offered as an alternative material in more valuable market segments.

GualapackGroup therefore promotes and advocates the collection of all packaging, and specifically the flexible plastic fraction of household waste. It is fundamentally necessary to collect all plastic, and improve sorting technology, so that materials can be more easily recognized and separated correctly. Also, it is imperative that flexible packaging be designed for a circular economy, meaning that a new product should already be conceived with sorting and recycling in mind; this means use of IR-detectable info markers included in the print, thermally stable ink that will not degrade upon first or second extrusion of the material, choice of adequate adhesives and avoidance of certain polymers, colors, or additives.

GualapackGroup is actively working to improve the recyclability of its packaging solutions and is at an advanced stage of prototyping and developing its first monomaterial, recyclable spouted pouch.

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