



Department of *Economics and Finance*

Bachelor Thesis in *Management*

**The Circular Economy Process:
Building an Effective Plastics Recycling and
Creating Demand for Plastic Waste**

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Introduction

Our linear take-make-and-dispose economic model is approaching its physical limits: current markets and policies do not deal properly with scarce and strategic resources and prices do not reflect the true cost of resources because the importance of ecosystems is still widely undervalued.

The need of radically changing the way our society generates value is becoming more and more apparent, and the Circular Economy seems to be the perfect solution to solve current world's problems.

A Circular Economy relying on renewable resources is needed to preserve natural capital and ecosystems and to minimize the risks associated with limited stocks. Such model, which is based on the idea that the economy is a metabolism rather than a machine and that waste has to build capital rather than decrease it, relies on IT as main enabling technology. A Circular Economy preserves, enhances and regenerates capital, is dynamic and adaptive and seeks to optimize the whole rather than the parts, recognising their interdependence. It is based on service models rather than on consumption ones making use of long-life products that can be disassembled, reused or regenerated indefinitely into new things.

On the road towards a more resource efficient future, plastic constitutes a significant opportunity thanks to its versatility, durability and other unique characteristics that make it an attractive material in sectors like automotive, construction and packaging.

However, it is necessary to enhance the circularity of plastics to prevent it from entering and damaging the environment. The first thing people can do is reduce the amount of plastic they use. The next important thing is to make sure that all the plastic used is properly recycled rather than thrown away, in order to alleviate the environmental burden caused by its production. Indeed, recycling is about 60% less energy-intensive than creating plastics from virgin feedstock: just think that, for each ton of recycled plastic more than 16 barrels of oil are saved. Less plastic would imply fewer greenhouse gas emissions and less waste contaminating the soil and the oceans.

But recycled plastics is not perfect: if compared to other resources and materials, it is still energy- and water-intensive. Moreover, the perception that plastic is easily recyclable could lead people to make an inappropriate use of it since they would feel comfortable using more.

Nonetheless, recycled plastic still represents an eco-friendly and versatile resource that would help to address the problem of the already existing plastic waste that contaminates our planet.

Moved by recent initiatives in my community and worldwide concerning the use of plastics, I have decided to combine my interest for the environmental sustainability area with my economic background in the hope of contributing to the still much needed research in this field.

In the first chapter I will introduce the Circular Economy concept, its history, practical applications and schools of thought; and in the following one I will move my attention to the creation of a Circular Economy for plastics. In the third chapter I will focus mainly on the recyclability of plastics and the challenges it currently faces. I will then analyse a few practical cases of firms that deal with recycled plastics on a daily basis and make of it the core of their business model, hoping to identify their critical success factors. I will conclude my analysis by broadening my findings to the general case and highlighting the priority actions necessary for the achievement of a Circular Economy.

1. The Circular Economy

1.1 The Linear Economy

Until the beginning of the last century, scientific method was based on the worldview that everything was mechanical in character, and so was the economy, generating prosperity endlessly by turning materials and energy into goods and services.

Especially during the last 150 years, the economy worked as a machine, taking in resources and using them to build and maintain a mass production, consumption and ultimately throwaway society. The rising living standards in the west showed the benefits of this linear system, which relies especially on cheap energy and materials and costly wastes both resources and finished products. Indeed, what is not strictly inside the money-valued cycle is carelessly dumped onto the environment, eventually impacting society.

But this mechanistic worldview is inadequate for the economy, the assumptions on which it is built are not the full story and the factors that made it so successful have shifted.

Consumerism has its roots in the 20th century, where goods were remaining unsold partly because they lasted a long while and could be repaired. In the 1930s manufacturers learned the way to protect their businesses: they boosted demand by driving a change in consumers' mindset. Since that moment spending was encouraged as people were persuaded that more was better, that new goods were preferred to old ones and that owning was superior to sharing or renting. Manufacturers started designing products which suited the mass production line and had much shorter life cycles, which resulted in more sales while they limited the liability of the producers for the soundness of the goods or their final destination. By doing so, the economy base became disconnected from its resources base, which were assumed to be endless and were consumed always more and faster, driven by individuals and businesses' decision making aimed at maximizing present utility. Therefore, the resources flow accelerated while a parallel flow of waste materials piled up.

This behaviour has been justified by the widespread idea that the solution somewhat lies inside the problem, that is that increasing economic growth would allow enough surplus to fix and compensate for the damages caused.

Undoubtedly, this take-make-and-dispose system powered by fossil fuels created the comforts of the modern world. But machines work as long as there are resources to transform and sinks for the wastes, and as long as there is credit for investments and enough economic growth to

pay for it all. Nevertheless, resources are getting more and more expensive to extract, waste sinks are full, credits for individuals are constrained and the economy is quite stagnating, while three billion of new middle-class consumers wait for their needs to be satisfied.

According to Walter Stahel,¹ this wasteful strategy that turned services into products to be sold has resulted into goods of inferior quality, the linear system built upon enormous quantities of easily accessible resources is unfit for the context in which it performs, and not even working efficiently increases the finite quantity of the stocks, but only delays their depletion.

The prosperity created through the inefficient and intensive use of resources cannot last as long as the role of ecosystems and biodiversity is undervalued and the cost of waste is not internalized in prices. Additionally, current public policies and markets do not deal properly with strategic resources (i.e. water, land, minerals, etc.) and their constraints. Considering that an incremental change is not going to work, a shift of the whole operating system seems necessary, and this can be done only through a coordinated modification of a wide range of policies aimed at sustaining prosperity in the long run.²

The change does not necessarily require a shift in values, but a model that engages with the changing facts on the ground and embraces an expanded and richer vision in which the economy is not machine-like, but a metabolism, a complex adaptive system composed of mutually interdependent realities. This new perspective through which to view the economy relocates the linear as an exceptional rather than general case.

1.2 Introduction to Circularity

Now imagine the economic models as circular, a place where resources are used rather than used up, where ‘throughput’ gives way to ‘roundput’, and where the feedback generates new flows of goods and services while restoring capital.

¹ Walter R. Stahel, “The business angle of a circular economy – higher competitiveness, higher resource security and material efficiency.” *The Product-Life Institute*, EMF volume 15.05.12. (November 2012).

² European Commission, “A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy.” *Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*. COM(2011) 21 final, (Brussels, 26.1.2011).

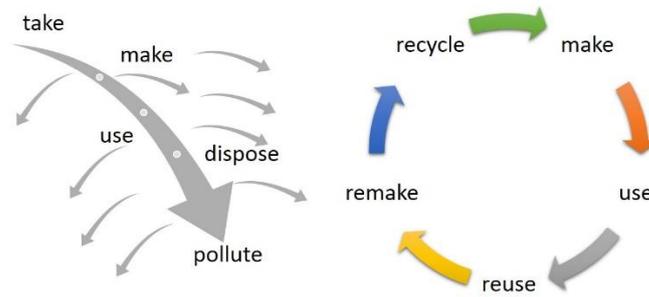


Figure 1: Linear versus Circular Economy (Source: CC 3.0 Catherine Wetman 2016)

A circular economy would be the result of multiple forces, such as the interaction of materials and energy supply, prices, growth and demand worldwide, and other externalities, even the uncostered ones. It would take into account resource and energy transformation as well as changing demographic and digital disruption.

Actually, information technology would be the central catalyst, as it enables the development of new business models, stimulate entrepreneurs and is able to revolutionize people's relation with the industrial economy by enabling the rethinking of materials, energy and credit flows. The result would be a virtuous cycle of capital building rather than a vicious cycle where human, social, natural and manufactured capital are transformed into financial capital which is not recirculated and does not reach all parts of the economy to facilitate exchange.

A regenerative circular economy is restorative by intention and creates wealth by creating an effective (not just efficient) flow of materials, energy and information and simultaneously maintains or increases stocks. It is not a rejection of industrialization, but a reconnection and recontextualization of it, which redefines growth by focusing on positive society-wide benefits. The circular model framework refers to an economy that aims to rely on renewable energy, eliminates waste through accurate design and tracks, minimizes, and hopefully eliminates the usage of toxic chemicals. By taking major insights from the living systems, a circular economy is dynamic and adaptive, and pursues the optimization of the whole rather than of the single components. In addition, for (circular) markets to work, prices need to act as messages by reflecting the full costs of their materials, components and processes.

1.3 Circular Economy Definition

To summarize, the circular economy aims at reinventing progress taking into account the interplay between the economy and its context, and that can be accomplished by building a model which is regenerative and restorative by design, reduces waste and avoids pollution by expanding the life cycles of products - which no longer have a beginning nor an end - and keeps goods, materials and components at the highest value and utility all the time.³

We can break down the circular model into three main levels: firstly, it seeks to preserve and enhance natural capital by stabilizing the flow of renewable resources and carefully monitoring finite ones, while at the same time creating conditions for regeneration through the encouragement of nutrients flow. Secondly, it comes the optimization of resource yields, that is all materials and components have to circulate at their highest utility. This necessarily requires the system to be looked at as a whole, rather than each component being considered separate from the others. Thirdly, system effectiveness must be fostered by removing negative effects and managing side effects in order to reduce harm to human utility such as food and health.

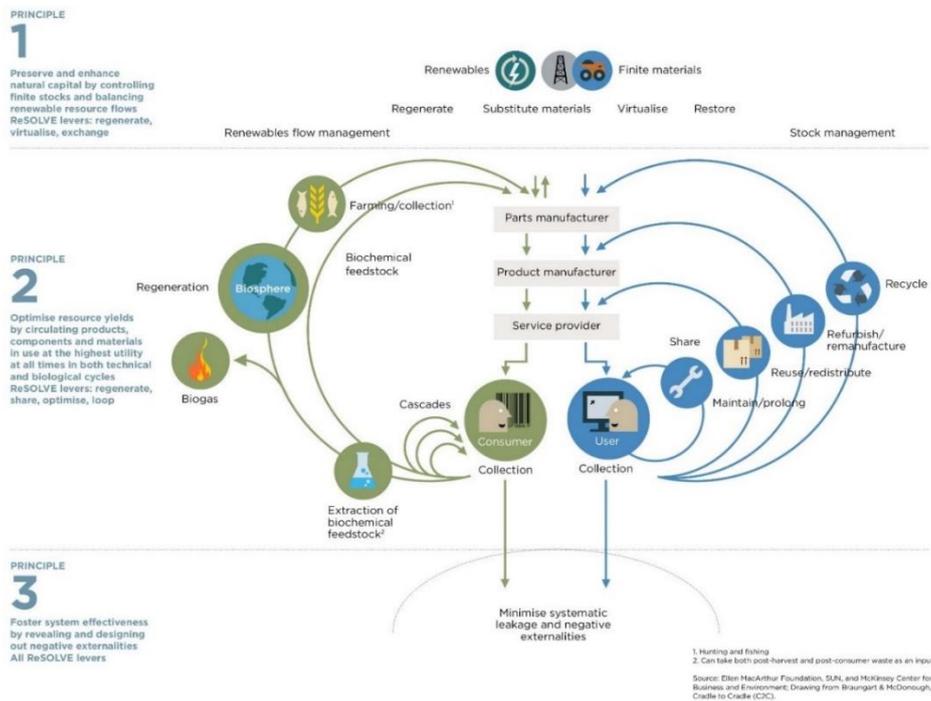


Figure 2: Circular Economy System Diagram (Source: Ellen MacArthur Foundation)

³ Elizabeth Pulliam, “3 Principles of Circular Economy.” *Packaging School*, (September 24, 2018). [online] Available: <https://www.packagingschool.com/blog/2018/9/20/3-principles-of-the-circular-economy>

Going more in depth the circular approach can be broken down into five major categories of actions:

1. Design out waste: if materials are designed by intention to fit into the environment without harming it when they are disposed of, the concept of waste is eliminated. That is not only limited to recycling, which often results in inferior quality products, rather in designing goods so that their components can be disassembled and repurposed;
2. Build resilience through diversity: in our uncertain, fast-evolving world features like modularity, adaptability and versatility need to be prioritized as diverse systems are more resistant than ones with few connections and scales to external shocks;
3. Work towards using energy from renewable resources: before starting any process and operation, one should look at the energy involved in the entire production process. This could be efficiently done by shifting taxation from labour to energy and materials consumption to tackle the problem more directly, and would fasten the adoption of more sustainable business models;
4. Think in systems: it is crucial to acquire the ability to understand how parts influence one another and how they interact with the whole. Real world systems are complex and feedback-rich; thus outcomes are not proportioned to inputs and can result in unanticipated reactions. It seems obvious that such systems cannot be managed in the linear way as businesses have to fit the economy, and efficiency is welcome only in the service of effectiveness. This system optimization results in reduced risk for businesses and thus in lower costs, fewer regulatory concerns increased cash flows.
5. Think in cascades: the peculiarity of biological materials is that additional value can be extracted by cascading the products through other applications, thus biological entities should be considered in their entirety. Indeed, in biological decomposition material is broken down in stages by microorganisms that extract energy and nutrients from the molecules.

In other words, the notion of circularity demands a major shift from simple to complex, from mechanistic, efficient, predictive and independent models to behavioural, effective, adaptive and interdependent systems. The focus must be paid on group diversity and cooperation rather than on individual ability and competition, so that simple win-lose situations can give way to strongly reciprocal win-win or lose-lose ones.

1.4 Theoretical Background

There is no real moment in which the circular economy concept came into existence, nor it can be traced to one single author. Rather, it is based on a variety of principles that started to gain momentum in the 1960s, when the first pictures of the Earth from the space were taken and raised humankind's awareness of our planet's fragility. In this decade many books and essays promoting the idea of Industrial Ecology were published, such as Boulding's "the Economics of the Coming Spaceship Earth", in which he stated that the economy should be looked at from a different perspective since the current one does not account for the Earth's finite resources. In 1977, the notion of recycling and reconditioning within the industry was first introduced by Stahel and Reday-Mulvey in "The Potential for Substituting Manpower for Energy". In this report to the Commission for the European Communities, they also stated that manpower should be preferred to machines as it does not use energy coming from finite resources and does not generate emissions.

Only in the 1990s the concept of circularity was introduced, as Pearce and Turner developed the first entirely closed circular model and published the book "Economics of Natural Resources and the Environment". Their model was also the first one to include the welfare factor (utility) by saying that while consumption increases welfare, amount of waste above the absorbing capacity of the environment decreases utility and negatively affects future generations as well.⁴

Practical applications to modern economic systems have been refined and developed in the main following schools of thought:

- *Regenerative Design*

During the 1970s, the American John T. Lyle worked towards the development of applications on regenerative design that could be implemented to all systems, rather than just to agriculture as it had been previously done. Regenerative processes are those that revitalize, renew and restore their own materials and energy sources, and the aim of regenerative design is that of ultimately creating dynamic, equitable and resilient systems that combine the needs of society with those of nature and are beneficial to both.

⁴ Maurits Korse, "An Extensive History of the Circular Economy." *Faciò*, Last modified June 5, 2019. [online] Available: <https://blog.mauritskorse.nl/2016/01/history-circular-economy/>

- *Cradle to Cradle*

This design philosophy was born in 1992, when the American architect William McDonough and the German chemist Michael Braungart published ‘The Hannover Principles: Design for Sustainability’. Three years later they published their masterpiece ‘Cradle to Cradle: Remaking the Way We Make Things’, in which they divided materials into biological and technical and described their use periods and evolution. Later on, they developed the Cradle to Cradle concept and certification process, and funded a non-profit institute (Cradle to Cradle Products Innovation Institute) with the aim of driving change thanks to open source information. This framework, which aims at creating a waste-free society, is based on the idea that all materials are nutrients that must be designed for effectiveness and classifies them as biological or technical. Biological nutrients are organic material that can easily be disposed of in any natural environment and safely re-enter the biosphere and reconstruct natural capital; while technical nutrients are non-toxic, non-harmful synthetic materials that must be designed to flow in continuous cycles at high quality and without losing their integrity. In this way materials can be used repeatedly within these metabolisms without entering the biosphere and without being downgraded into inferior products.

Cradle to Cradle also proposes a shift towards clean and renewable energy and seeks to eliminate the concept of waste, which ‘equals food’. At the same time, it celebrates diversity as it is the source of both resilience and creativity in every system.⁵

- *Industrial Ecology*

This approach focuses on material and energy flows and on connections between agents within the industrial ecosystem and has as objective the creation of closed-loop processes where undesirable by-products do not exist since waste is constantly used as input, emphasizing capital restoration and social wellbeing. Industrial Ecology attempts to shape products that perform similarly to living systems and in accordance with local ecological constraints while keeping under control their global impact.

- *Performance Economy*

In 1976, Walter Stahel and Genevieve Reday described the vision of an economy in loops in their research report to the European Commission: ‘The Potential for Substituting Manpower for Energy’. In the report they also analysed the impacts that a circular economy would have on many aspects of the economy, such as job creation, competition, resource savings and waste

⁵ Cradle to Cradle, “Starting a Revolution,” About the Institute, Accessed April 26, 2019. [online] Available: <https://www.c2ccertified.org/about>

prevention. In 1982, Stahel founded the Product Life Institute, which is located in Geneva and pursues four main objectives: waste prevention, reconditioning activities, product-life extension and the creation of long-life goods, along with promoting service sale rather than product sale.

- *Biomimicry*

Janine Benyus's 'Biomimicry: Innovation Inspired by Nature' (1997), describes 'a new discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems'.⁶ For instance, it could imply taking inspiration from a leaf for the invention of a better solar cell. Biomimicry can be defined as 'innovation inspired by nature': it takes nature as model and tries to emulate its shapes, processes, systems, and strategies to solve human problems. Nature is also considered as a measure in that sustainability should be measured according to ecological standards; and as a mentor, as mankind should learn from nature's models rather than simply extracting value from it.

1.5 The Service Model

For circular models to be implemented, a sharp distinction must be drawn between consumption and use of materials. In fact, circular models require functional service models in which manufacturers and retailers retain, when possible, the ownership of their products, acting in this way as service providers. When the one-way consumption is sold rather than the use of a product, like in the current linear model, manufacturers have no incentive to design for durability, rather they focus on low unit cost. But as Gunter Pauli says,⁷ the aim should be that of extracting as much value as possible from a resource instead of trying to minimize costs. When items are designed to be returned after use, that is, to be products of service rather than consumption, they are conceived for disassembly or repair, resulting in resources being used efficiently. This way of internalizing costs benefits consumers by creating products that are long lasting, safe, reliable and easily upgradeable, that do not have end-of-life issues because the materials used become food for manufacturers instead of waste for the environment.

This different approach to business provides completely new opportunities for innovation in many areas such as service and business models, product design, farming, biological feedstocks

⁶ J.R.J. French, B.M. Ahmed. "Biomimicry of Termite Social Cohesion and Design to Inspire and Create Sustainable Systems." (November 3,2010). [online] Available: <https://www.intechopen.com/books/on-biomimetics/biomimicry-of-termite-social-cohesion-and-design-to-inspire-and-create-sustainable-systems>

⁷ Gunter Pauli, "Blue Economy." Interviewed by Antonia Santopietro. *Zest, Letteratura Sostenibile*. (June 11, 2017). [online] Available: <http://www.zestletteraturastostenibile.com/intervista-gunter-pauli-blue-economy/>

and products and is able to work in the longer term because it decouples economic growth from the consumption of finite resources.

1.6 The Ellen Macarthur Foundation

The Ellen Macarthur Foundation, founded in 2010 by the woman from whom it takes the name, has as primary mission the acceleration of the path towards a circular economy, and has built a circular framework for business, government and academia to follow that simplifies the implementation of a circular economy down to three principles: design out waste and pollution, keep products and materials in use and regenerate natural systems. It has developed the idea of an economy in loops which follows several principles that, except number five, do not exist in a linear economy:

1. The smaller the loop, both geographically and activity-wise, the more resource efficient and profitable it is;
2. Loops have no beginning and no end;
3. The efficiency of managing stock increases with a decreasing flow speed;
4. Continued ownership is cost efficient: reuse, repair and remanufacture saves double transaction costs if no change of ownership occurs;
5. In order to work, a circular economy needs functioning markets.

Being such a broad and relatively new concept, there are many areas in which circular economy is still developing and many perspectives through which it can be addressed. To mention a few: issues of conflicts and agreements between stakeholders, the encouragement of R&D and the development of innovative business models and designs, how to include circularity in education and address it in policies.

1.7 Implications on politics

According to Herman Daly, abundance and excess capacity are a prerequisite for freedom and democracy. On the contrary, scarcity and the struggle for resources give birth to authoritarianism.

Thus, if we value democracy and freedom we should not grow up to the limit of carrying capacity, and we should implement a circular model able to bring widespread prosperity through access and abundance and aspire at creating the conditions for democratic approaches to persist by promoting a regenerative and restorative relationship with the environment.

2. The Plastics Economy

2.1 Introduction to Plastics Economy

Every day nearly everyone comes in contact with plastics somewhere. Cheap, versatile and light plastics are an important and integral part of people's everyday life and have become the dominant materials of the modern economy, because they combine low cost with functionality. Not only has their production and use increased exponentially in the past century (from 15 million tons in 1964 to 311 million tons in 2014), it is even forecasted to double over the next twenty years, as their areas of application increase and develop.

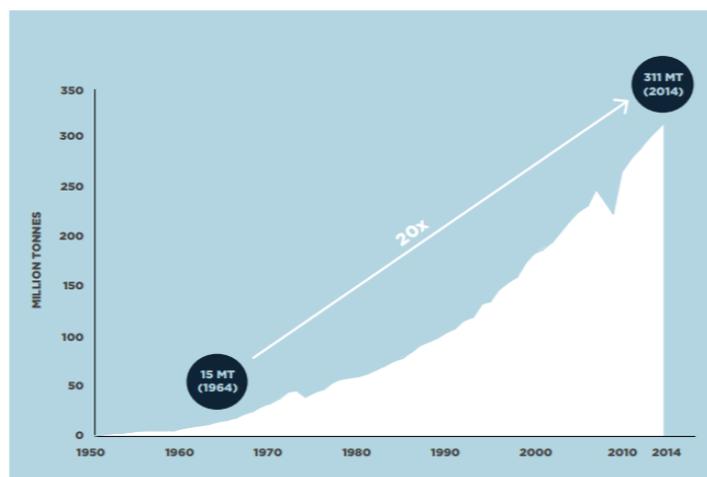


Figure 3: Growth in Global Plastics Production 1950-2014 (Source: *The New Plastics Economy: Rethinking the Future of Plastics*, Ellen MacArthur Foundation)

Despite delivering many benefits, the current plastics economy has drawbacks that, day by day, are becoming more and more apparent; in fact, plastics are one of the most wasteful cases of the linear take-make-and-dispose economic model. Every year, around 8 million tons of plastic enter the ocean, which is comparable to dumping one garbage truck per minute into the sea, and this amount is expected to increase to four per minute by 2050, outweighing the fish stocks. It has been estimated that, today, 150 million tons of plastics are stranded along the coastlines, float on the sea surface and lie on the seafloor, strongly impacting the biodiversity and human civilization causing health, environmental and economic consequences. Marine litter of all sizes is found almost everywhere, even where we cannot directly see it. Indeed, there is growing evidence showing that plastic particles carry and transport toxic substances such as endocrine

disruptors and enduring organic pollutants to marine species when they are ingested, dangerously transferring via food chains.

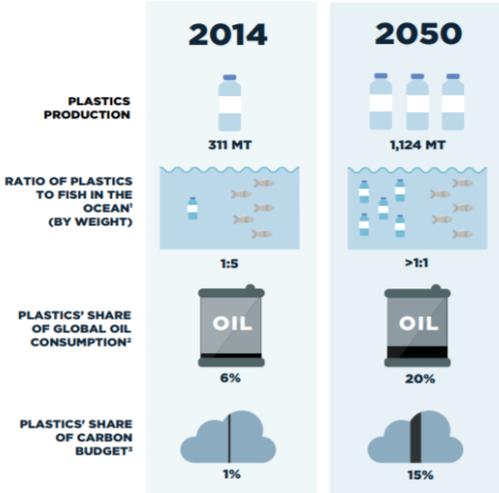


Figure 4: Forecast of Plastics Volume Growth, Externalities and Oil Consumption in a Business-as-Usual Scenario (Source: The New Plastics Economy: Rethinking the Future of Plastics, Ellen MacArthur Foundation)

But the problem with this material begins long before it is disposed in the beaches, rivers and oceans: in fact, estimates suggest that the main share of this leakage consists of plastic packaging. Less than 15% of all plastic packaging is collected for recycling, causing a loss of USD 80 to 120 billion per year, that corresponds to 95% of plastic packaging material value. Furthermore, about 32% of plastic packaging does not reach the collection systems, reducing the productivity of natural systems and urban infrastructures. This happens because the introduction of new packaging formats and materials is developing faster than the deployment of associated after-use infrastructures and systems. Moreover, if we add the cost of after-use externalities from plastic packaging to the one associated with greenhouse gas emission deriving from its production (which consumes 6% of global oil consumption and corresponds to the oil consumed by the global aviation sector), the resulting comprehensive cost, amounting to USD 40 billion per year, is greater than the plastic packaging industry total profit.

There is an urgent need to radically rethink the global plastics system, and business and governments are only now starting to recognize it. They should put effort into eliminating the plastic goods we do not need and innovating the amount we do need to make it safely reusable, recyclable and compostable. In other words, all plastics should be circulated and kept within the economy rather than in the environment.

Governments and businesses should overcome the above-mentioned drawbacks by exploiting the plastic innovation engine to enhance system effectiveness to achieve better environmental and economic results while capturing the multiple benefits of plastic packaging. This new vision could best capture new opportunities if in line with circular economy principles, so as to create effective after-use plastics economy by reducing negative externalities such as the leakage of plastics into the environment and by decoupling from fossil fuels stocks.

Today there are many innovations that show potential as thousands of small-scale local initiatives aimed at enhancing collection schemes and reprocessing technologies are launched every year, but the efforts are too fragmented and uncoordinated to have a significant impact. According to a recent study, more than half of plastic packaging could be recycled economically and environmentally effectively in Europe. However, even if opportunities to capture exist, they cannot be fully realized because the high level of fragmentation of the plastics economy makes them unfeasible.

2.2 A New Plastics Economy

According to the Ellen Macarthur Foundation, a new plastics economy could be achieved by implementing three actions:

1. Create an effective after-use plastics economy

This is the priority of the New Plastics Economy model designed by the foundation and consists of capturing more material value by increasing resource productivity while providing targeted economic incentives for avoiding leakage into the environment.

This would be done by radically improve recycling, its grasp, economics and quality and mainly focusing on innovations that are likely to scale up. There is urgency to develop a global plastics protocol which would indicate ways to redesign materials, formats and after-use systems aimed at improving the collection, reprocessing and sorting of yields.

Policy interventions are necessary to ensure commitment by the industries to create and protect a secondary market for recycled materials. The priority is placed on the adoption of business-to-consumer reusable applications (i.e. plastic bags) and on business-to-business ones, but mainly on scaling up the adoption of compostable plastic packaging at the industrial level (i.e. garbage bags for food packaging and organic waste) in areas where combining organic content with compostable package material enables nutrient return to the soil.

2. *Drastically reduce the leakage of plastics into natural systems and other negative externalities*

This action requires joint efforts in four areas:

i) Improve after-use collection, reprocessing and storage infrastructure in high-leakage countries. Such critical step requires complementary actions because it is not sufficient alone since, in the best scenario, the flow of leakage into natural systems would only be stabilized, not cancelled, thus continuing to raise the volume of garbage in the ocean.

ii) Increase the economic attractiveness of keeping materials in the system. Raising the value of after-use plastics decreases the chance that it escapes the collection system, and incentivizes the improvement of reprocessing and collection infrastructure, therefore it would constitute the root-cause solution to leakage.

iii) Reduce the negative environmental impact of plastic when it escapes the collection and reprocessing systems and becomes leakage. The design failure of current plastic packaging lies in the fact that the intended useful life of the items is usually less than one year, while the material they are composed of survives for centuries. This evident contradiction requires innovation investment for creating 'bio benign' formats and materials that can be competitively recycled but also that minimize the damage to the environment when they are leaked. This function is not performed yet by current biodegradable plastics, as they are generally compostable only under specific and controlled circumstances such as industrial composters.

iv) Scale up and accelerate existing efforts related to the understanding of the impact of concerning substances in order to speed up the development of safe alternatives.

3. *Decouple plastics from fossil feedstocks*

This third element is the key for creating an effective after-use economy because it would allow plastics to take part to the advancing low-carbon world. Despite the increased reuse and recycling, decoupling plastics from fossil feedstocks requires the development of renewably sourced materials to compensate for the virgin feedstock that fossil fuels currently provide.

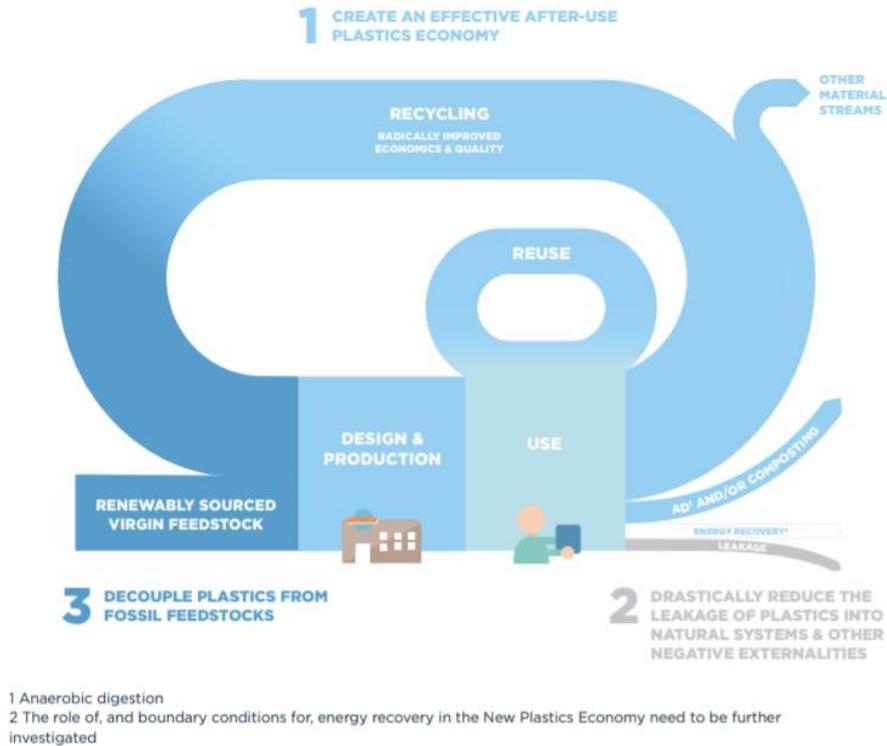


Figure 5: Ambitions of the New Plastics Economy (Source: *The New Plastics Economy: Rethinking the Future of Plastics*, Ellen Macarthur Foundation)

2.3 A New Approach

A new approach is necessary to move from small, isolated and incremental improvements to a systemic shift towards the New Plastics Economy where the initiative is global, concerted and collaborative and adequate for the scale of the challenge. Collaboration is required to overcome barriers such as fragmentation, lack of standards and lack of alignment between design and after-use. Such initiative can only be driven by an independent vehicle that coordinates cities, industries, governments and NGOs, each of which plays a key role in the transition: consumer goods companies decide what goods and materials are sold on the market, cities manage the after-use infrastructure, businesses engage in the collection, sorting and reprocessing, policymakers align incentives and define standards, and NGOs help ensure that wider environmental and social considerations are taken into account.

The initial areas of focus suggested by the Ellen Macarthur Foundation could be:

- *Establish the Global Plastics Protocol and coordinate large-scale pilots and demonstration projects.*

This would require exploring the extent and the potential of re-designing formats, materials and infrastructures, and setting a global direction by answering challenging questions, demonstrating solutions, proving economic effectiveness and driving global convergence.

- *Mobilize large-scale ‘moon shot’ innovations*

‘Moon shot’ innovations are focused and practical initiatives with significant potential for considerable impact at scale, they must be defined by world’s leading academics, innovators and businesses and should focus on the development of bio-benign materials designed to facilitate multiple reprocessing.

- *Develop insights and build an economic and scientific evidence base*

Most of the central aspects of plastics flows and the economics behind them are still inadequately understood. Recent reports provide only basic answers, therefore further research is required to investigate in detail aspects like environmental, social and economic benefits of innovations and impacts, risks and externalities of ocean plastics waste and other substances of concern.

- *Engage policy makers*

Policy makers should be engaged in developing a common vision of an effective plastics system and provide people with tools, insights, data and above all a structured methodology to help make such opportunity become reality.

- *Coordinate and drive communication*

In order to make the above-mentioned changes happen, knowledge about current situation and the vision of a New Plastics Economy must be spread, as well as the best recommendations to stakeholders.

The New Plastics Economy also aims at mitigating the risk associated with greenhouse gas emissions through recycling and increasing reuse. Indeed, each ton of plastics that is recycled reduces emissions by 1.1 to 3.0 tons of CO₂ if compared to producing the same quantity from virgin fossil feedstock. Moreover, by encouraging transparency about material content, research on potential negative effects and the development of safer materials, this new model helps reducing risks deriving from the employment of substances of concern.

The risk reduction arising from the control and decreasing of negative externalities would result in real benefits for businesses, which would not have to deal anymore with regulatory risks such as the internalization of negative externalities (i.e. carbon tax), nor with the risk of seeing their product materials banned.

Another risk that would be reduced by the New Plastics Economy is that of volatility of fossil fuels' price. In fact, the unpredictable cost of supply for fossil feedstock-based plastics is a hazard that could be reduced by employing renewably sourced alternatives. It must be highlighted that price volatility would not be completely eliminated because plastics price would still be subject to local market pressures, but diversification obviously spreads the risks. In this sector it is fundamental to invest in broadening the array of renewably sourced feedstocks and materials.

2.4 The Right Moment to Act

A combination of favourable factors makes now the appropriate moment to go deeper in this transition. New technologies are freeing new opportunities in fields like material design, separation and reprocessing technology and biodegradable and renewably sourced plastics. Furthermore, a large number of developing countries is starting to construct after-use infrastructure, thus passing a critical turning point, and an increasing number of governments are adopting policies concerning plastic packaging. In 2002, Bangladesh was the first country to ban plastic bags, as they were found to have choked drainage systems during some devastating flood, and Rwanda and China followed suit in 2008, the latter reducing the amount of plastic bags in circulation by 40 million in just one year. The European Commission has recently adopted the Circular Economy package, which comprises a set of actions to build a strategy on plastics within the circular economy framework; for instance, it plans to increase plastic packaging recycling to 55% by 2030. Since 2015, a European Union directive requires member states to significantly reduce the use of plastic carrier bags. For example, France completely outlawed single-use plastics bags starting from 2016. Overall, more than 25 countries either ban or tax single-use plastic bags around the globe, and other highly littered packaging formats are starting to be discussed as well.

Finally, there is an increasingly negative perception of plastics in relation to issues such as health and the environment, which are progressively capturing the attention of individuals as well as policy makers, thus jeopardizing the plastics industry’s license to operate.

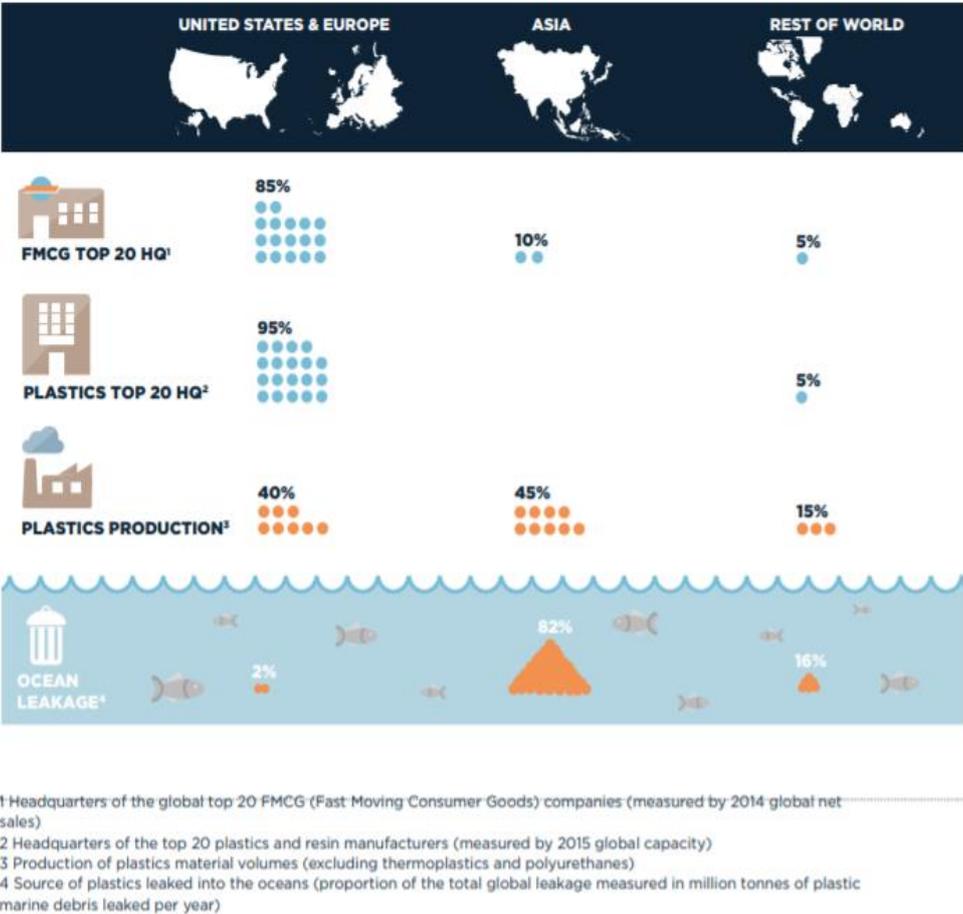


Figure 6: Distribution of Plastics Headquarter, Production and Leakage (Source: The New Plastics Economy: Rethinking the Future of Plastics, Ellen Macarthur Foundation)

As can be inferred from the figure above, roughly 85% of global plastics production takes place in Europe and the United States, therefore they constitute the perfect place where to begin the transition. On the other hand, Asia produces about 10% of world’s total plastics amount, but it accounts for more than 80% of the total plastic leakage into the ocean, thus leakage mitigation efforts for correcting and enhancing collection infrastructure are crucial in this region.

Given that the United States and Europe are home to the majority of the top global companies and decision-makers relevant to the plastic industry, the majority of the opportunities around innovation and redesign are emerging on these regions.

2.5 Catalysing Action

Over 40 years after the launch of the first universal recycling symbol, the issue of plastics is coming to a head. The question is whether this material will be rejected by people due to its downsides or if innovation will prevail to enhance its benefits in line with the circular economy principles.

In 'The new plastics economy - Catalyzing action', the Ellen MacArthur Foundation has identified a set of three priority actions to fasten the transition towards the New Plastics Economy that are based on the following insights:

1. Without fundamental redesign and innovation, about 30% of plastic packaging (by weight) will never be reused or recycled.

This category represents more than half of the existing plastic items, is made up of four segments: multi-material packaging, small-format packaging, nutrient-contaminated packaging and uncommon plastic packaging materials (see Figure 3). These packaging types offer high functionality but do not have an applicable recycling or reuse approach, nor they are likely to have it in the expected future; thus they need to undergo a major redesign and innovation of formats, materials and after-use systems in order to enter a positive material cycle.

2. For at least 20% of plastic packaging, reuse provides an economically attractive opportunity. Until around 50 years ago, reusable packaging was a widespread choice, but that changed in the last half century as disposable packaging became a preferred choice. Nowadays common sense is again moving towards reuse models, which are now perceived as more attractive thanks to evolving use patterns and recent innovations. Within this category lie personal and home care bottles, carrier bags, beverage bottles, pallet wraps and large rigid packaging.
3. With concerted efforts on design and after-use systems, recycling would be economically attractive for the remaining 50% of plastic packaging.

Currently, only 14% of global plastic packaging is recycled, and this is due to the fragmentation and often under-development of the after-use systems, which encounter many challenges in gathering and processing the different packaging materials and formats and thus prevents economy of scale. In most cases the cost of the collection, sorting and recycling of plastics (which in Europe is estimated to be around USD 170-250 per ton collected) exceeds the revenues, and much of the plastic that is recycled is turned into lower-value applications that cannot be recycled a second time. A co-operational and cross-value approach in the design, after-use systems, economics and quality of recycling uptake is strongly needed, and could

increase revenues in the OECD region by USD 2-3 billion per year. This path would make recycling a cost-competitive and attractive alternative to practices such as incineration and landfill, and would decouple the plastic system from fossil feedstock, thus reducing negative externalities like greenhouse gas emissions.

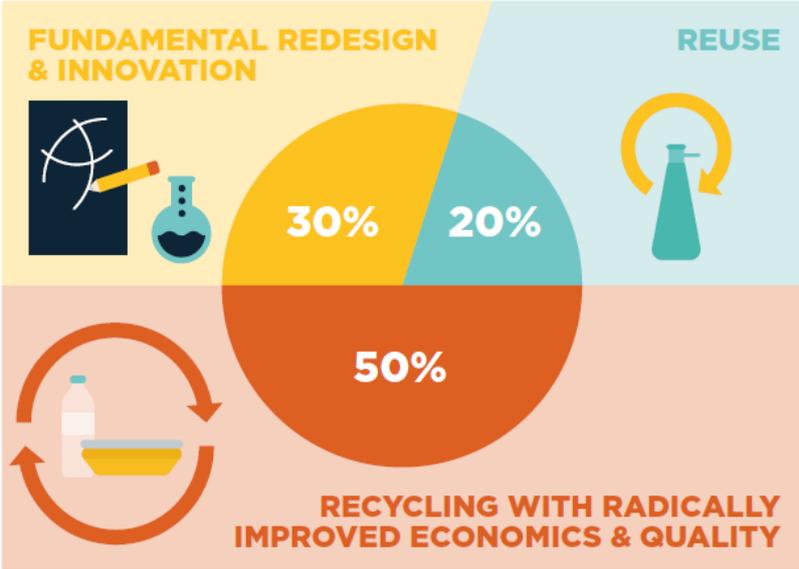


Figure 7: Three Distinct Transitions Strategies to Accelerate the Shift Towards the New Plastics Economy (Source: *The New Plastics Economy: Catalyzing Action*, Ellen MacArthur Foundation)

Implementing a Global Plastics Protocol would boost the average profitability of plastic recycling, but critical challenges would still remain for certain material sectors (i.e. technological barriers for sorting post-consumer films).

It must be noted that the estimates of the report are based on current plastic prices, but the situation would obviously change in response to changes in the prices of the material.

If innovation were to be combined with harmonization of packaging design and after-use systems, that would establish a positive feedback loop system, an upward spiral where there would be financial incentives to collect and recycle more plastics, which would in turn increase the volumes and create economies of scale which would set incentives for better material designs to further increase collection. Eventually, this self-reinforcing loop would enable recycled material quality to overcome leakage and economic value loss.

In the short term, progress should be sought through support supporting policy measures such as recycling targets, eco-design rules, virgin resources taxes, extended producer responsibility

(EPR) schemes and levies or bans on incineration and landfilling, so as to create the enabling conditions for the shift to happen.

It should be noted that the 50% above described should be considered a lower rather than an upper limit for recycling uptake.

These policy measures require deep investigation, as they come with advantages and disadvantages and depend on local contexts, thus they should be analysed within them. For instance, even though improving plastic packaging is a critical action for both advanced and emerging countries, the latter usually require basic collection and deployment systems as a critical action in the short-term in order to prevent leakage in natural systems, and thus require a different path towards adopting the Global Plastic Protocol.

To summarize, the basic actions to improve the quality, economics and uptake of recycling are:

- Change the design of plastic packaging to enhance recycling;
- Harmonize the practices for collection and sorting systems;
- Increase quality and yields of materials;
- Scale up recycling processes;
- Use policy instruments to increase demand for recycled plastics;
- Set up suitable collection and sorting infrastructures where they do not yet exist.

The table below presents an overview of the priority actions identified for global plastic value chain that will mobilize the distinct transition strategies for the three plastic packaging categories.

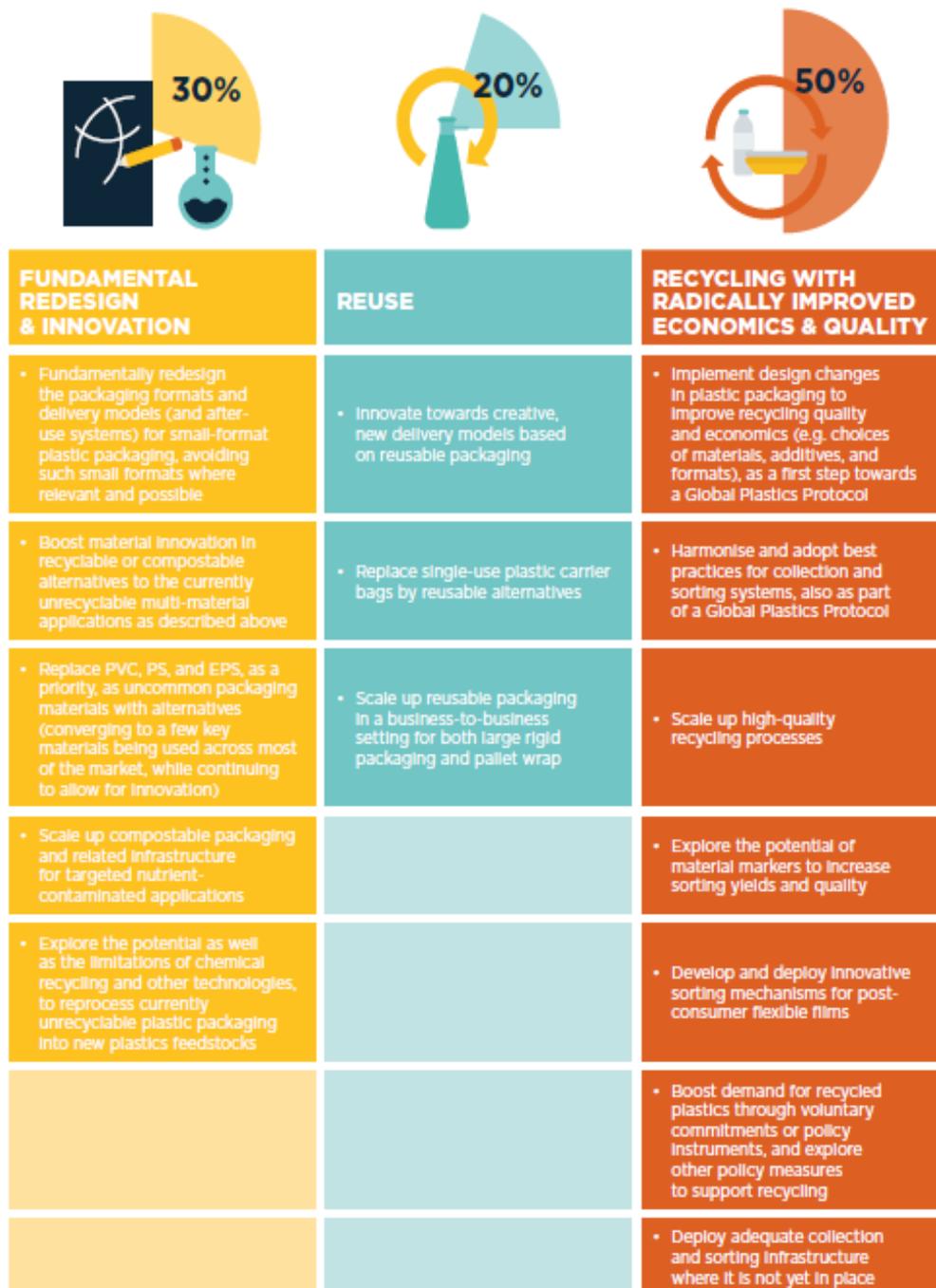


Figure 8: Priority Actions for the Global Plastic Packaging Value Chain to Mobilise the Three Transition Strategies Towards the New Plastics Economy (Source: The New Plastics Economy: Catalyzing Action, Ellen MacArthur Foundation)

3. Plastics Recycling

3.1 The Role of Consumers

As highlighted in the previous chapters, the transition towards a circular (plastic) economy unquestionably requires coordinated actions by multiple stakeholders, since business, governments and consumers are fully interrelated. Besides all the business initiatives and governmental policies, the choices made by consumers are what ultimately determines the success or failure of circular economy initiatives and the pace of the changeover to a circular economy, thus it is fundamental to cast a glance into this group.⁸

For as long as there have been sellers and buyers, the power balance between them was inclined to favour the former. But that is changing. Nowadays, buyers are more empowered than ever before thanks to the broadening of choices and hyper-connectivity. Technology plays a major role in this shift, changing the way consumers relate to what surrounds them and the way they are informed, inspired and influenced, placing them at the centre of their own ‘world’.⁹

In this ‘Customer 4.0’ reality, buyers choose sellers who help them achieve their objectives, and seek experiences rather than just features.

Businesses that do not acknowledge this critical shift and the importance of after-sale engagement with clients risk a quick decline in value to their customers and will be left behind.

From a 2018 behavioural study on consumers’ engagement in the circular economy,¹⁰ which studied the extent to which consumers are currently involved in CE practices and what determines their engagement, it emerges that European consumers are inclined to engage in the Circular Economy, but their real engagement is somewhat constrained, in the sense that it is limited by the range of possibilities offered to them (Nita, et al., 2017). This indicates that there is potential to extend Circular Economy practices further, but something needs to be done to make possibilities become reality.

⁸ Hanna Fux, “What is the Ideal Scenario for Circular Economy to Occur? A Case Study of the Circe Project.” *Cardiff University* (June 2018).

⁹ PA Consulting Group, Walmart, Ellen Macarthur Foundation. “Why customers relationships don’t have to end at the point of sale – lessons from the Circular Economy.” *Keeping customer connections, CE100*. [online] Available: https://www.ellenmacarthurfoundation.org/assets/downloads/ce100/CE100_Report_Retail_Customer_Final.pdf

¹⁰ Annette Cerulli-Harms, “Behavioral Study on Consumers’ Engagement in the Circular Economy.” Final Report, (October 2018).

It is common knowledge that what mainly influences consumers' purchase decisions are price, quality and convenience. As stated in the previous chapters, a key action required for the CE framework is extending the life span of goods by making them easier to repair and more durable. In this way fewer products would be needed to satisfy the same demand level, resulting in a reduction of waste creation and a reduced use of resources. What consumers should do is thus shifting their purchases towards more durable products, repairing them when broken instead of substituting them and selling them in second-hand markets when they are no longer needed. Moreover, renting and leasing models should be implemented to expand the utilization rate of products used on an occasional basis.

If the effort necessary to repair products was reduced and the prices of durable products lowered and their quality raised, more pro-Circular Economy decisions would be taken by consumers when deciding about their purchases and repairs.

From the above-mentioned study it emerges that European consumers widely lack information about the durability and reparability of the products when making purchase and replacement decision but would make different choices if they had this kind of information at the moment of the decision. Therefore, if such knowledge was provided more responsible and sustainable choices would be made by consumers.

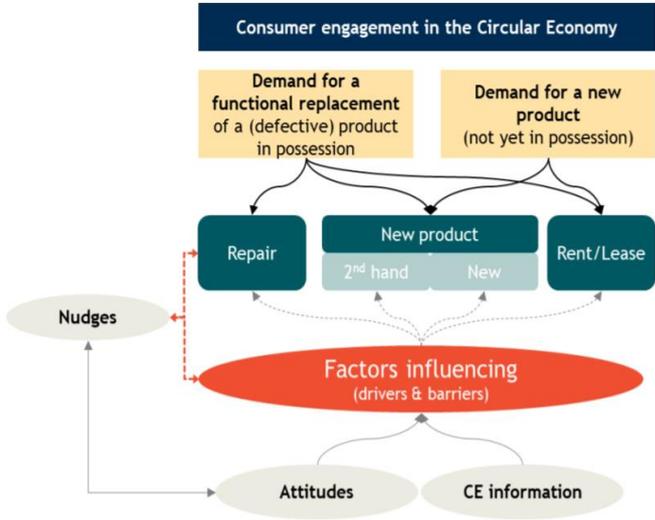


Figure 9: Consumer Choices in the Circular Economy and Factors that Influence their Decision-Making Process (Source: Behavioral Study on Consumers' Engagement in the Circular Economy Final Report October 2018)

The study also discovered that the majority of people prefer owning new and unused products and is somehow reluctant to second-hand purchases and product renting/leasing because it perceives second hand and repaired items as lessened goods. This barrier could be partially

overcome by increasing their awareness and knowledge about the advantages of durable products, but a major shift in mindset is needed to occur. While we wait for this shift to happen, purchases could be pushed towards items made of recycled materials, which, as a matter of fact, are new.

3.2 Barriers to Recycling

Post-consumer waste plastic is generated in multiple sectors such as agriculture and construction, but the wide majority comes from household waste stream.

Plastic waste constitutes a valuable resource that could be re-employed in the production of a wide variety of items, but is mostly underutilized due to several interdependent factors that act as barriers¹¹ to its recycling and prevent the development of this market:

1. *Lack of coordination and communication along the value chain*

The plastic value chain is constituted by multiple actors, diverse sources of feedstock and even a wider variety of the potential end applications. Moreover, the quantity and quality of the flow of materials is constrained by missing coordination and communication between the various steps, which prevents the collected plastic from finding its optimal use. For instance, producers almost never consider the recycling of their products when designing it, nor they are informed about the potential for recycling of different plastic mixes.

Even when products are designed for recycling (i.e. when the use of additives and complex mixes is avoided), once they leave the producer it is very hard to follow the path they walk during their use and disposal because consumers, waste managers and plastic sorters are not able to capitalize on it since all plastic waste is amassed and handled homogeneously.

Sometimes there is lack of coordination even between two strictly related steps, such as the one between a waste manager and a recycler. In fact, the former is not informed about the plastic quality required by the latter when he delivers him the containers with plastic waste, and the recycler just accepts or discard the boxes (rarely paying for them).

Lack of communication implies that, since recyclers do not know what quality producers need and are willing to buy, high quality waste plastics that could be used for higher quality end

¹¹ David McKinnon (CRI), Lena Holm Christensen (NIRAS) “Plastic Waste Markets - Overcoming barriers to better resource utilisation.” *Nordic Council of Ministers, Policy Brief: Plastic Waste Markets* (2018). [online] Available: <https://www.diva-portal.org/smash/get/diva2:1203194/FULLTEXT01.pdf>

appliances is used in less demanding applications because it gets mixed with lower quality material, and shredded to produce low quality granulate, which thus sold at a low price. On the contrary, a more thorough sorting would result in more differentiated granulates that producers would be more interested in buying, even at a higher price.

More generally, the difficulty of tracing plastic along the value chain impedes manufacturers to rely on the quality of the materials, therefore formal coordination based on quality criteria would help to overcome this barrier to a considerable extent.

2. *Technical barriers*

The market for recycled plastics is also limited by technical and logistic troubles in the process that transforms extremely mixed plastic waste portions delivered by consumers to clean and separated polymer types that are ready to be employed again in new products. The sequence of steps is crucial for defining the quality of the final plastic material and should be built in a way that the highest quality materials are used only by the industries demanding the highest quality.

More importantly, industries having lower quality demand should always use recycled plastics since the high quality of virgin plastic is not necessary nor required.

Separating plastic from other waste types is complex, especially if the aim is to achieve high quality materials. But the troubles do not end there: in fact, even when plastic waste is collected separately, it still contains impurities such as labels and glue, is made of different and complex plastic types and contains additives that require further processing to be removed.

Even in this case design for recycling could alleviate this problem by constructing products using single polymers that can be mechanically separated and avoiding additives that restrict recyclability.

It is essential to acknowledge that plastics degrade with processing and over time, posing a technical limit to recyclability. Sadly, at some point incineration may constitute the most environmentally friendly solution.

3. *Legislative barriers*

Currently, recycling is based on undifferentiated weight targets, which favour heavy materials like glass and metal. Since plastic is relatively light, it does not contribute much to meeting targets, and as a consequence it is not subject to the political attention it deserves.

Moreover, legislation is not harmonized across countries and often it differs substantially even across municipalities, which are subject to different guidance and practices concerning the

methods of collection and thus the quality of the rubbish. This diversification of waste policy and its implementation constitutes a barrier to an enhanced collection and sorting of waste, because plastic producers and waste management companies have to adapt their operations to different waste streams and practices.

Currently there is no standard criteria for classifying plastic waste and recycled polymers, and since manufacturers ignore the quality of the materials, they cannot design products based on their properties.

4. *Low demand for recycled plastic*

While the cost of recycling plastic is relatively stable, the cost of generating plastic from virgin feedstock fluctuates according to oil prices. In fact, when oil prices are high, the demand for recycled plastic increases since virgin plastic is more expensive to produce, while when oil prices are low, virgin plastic is preferred. This uncertainty about the demand for recycled plastic which causes instability in the market reduces the incentives to invest in long-term recycling infrastructure and technology.

The above-mentioned lack of information about the quality of the recycled material and its technical properties also hampers demand, because manufacturers have no prior knowledge about the chemicals present in the waste plastics and thus are not sure about whether and how they can achieve specific standards. If to this we add the fact that it is expensive to convert plants and processes that use virgin plastics to others using recycled plastics, and that consumer demand for products that can be easily recycled or made of recycled plastics is quite low, the barrier becomes even more significant.

It is exactly on this last barrier - low demand for recycled plastic - that I am going to focus my research from now on. In particular, I will examine how some successful start-ups managed to create demand for their products composed of recycled plastics.

3.3 Case Studies

The circular economy constitutes a new way of looking at the relationships between resources, consumers and markets through innovative and disruptive technologies, designs and business models.

It is an opportunity worth trillions, and some actors are already taking advantage of it, discovering and pursuing new business opportunities and ways to generate value, while at the same time reducing resource costs, benefiting society and the environment.

In this section I will analyse some of the most successful initiatives by private companies and start-ups that have made of recycling the core of their business, hoping to identify a common critical factor to their success.

- *Thread International (Pittsburgh, USA)*

Thread International was founded in 2010 by the American businessman Ian Rosenberg that, during a travel in the Caribbean, was shocked and at the same time inspired by the enormous local level of pollution and poverty.

Since its founding, the company has developed a process of recycling plastic waste of any kind into soft canvas-like fabric, which is sold together with a 100% transparent supply chain to whoever is interested in producing more responsible clothes and accessories.

Thread has built its success by partnering with notorious brands like Nike and Timberland and has recently launched its first direct-to-consumer product: a backpack for grownups loaded with features, which is available in three colours and is sold from 119\$.

Thread differs from the majority of clothes brands in that its intention is not to build a fashion brand that “puts out new products every two months in 20 colours”, but realizing items that “people use for life”,¹² investing in the poor to “create as many dignified, sustainable jobs as possible”.

In fact, in addition to full-time workers, the company employs several local residents for the collection of plastic waste in Haiti and Honduras, which is then processed into cloth and shipped to the United States. Thread claims that, since 2010, it has removed more than 200,000 pounds of recycled plastic from Haiti, and it is considering expanding its activity to Southeast Asia and Guatemala in the near future.

For what concerns the consumers information, they can find out where the plastic bottles used to manufacture their purchases are sourced from and the location where the fabric is sewn in the detail section



Figure 10: How a Former MTV Host is Creating Cleaner Clothes and Jobs in Haiti (Source: FastCompany.com)

¹² Sam Klein, “Thread International moves to Homewood, employs locals and launches its own line of recycled backpacks.” Interviewed by Bill O’Toole, *Next Pittsburgh* (August 13, 2018). [online] Available: <https://www.nextpittsburgh.com/city-design/thread-international-moves-to-homewood-employs-locals-and-launches-its-own-line-of-recycled-backpacks/>

of each product web page. The plastic waste undergoes 4 main steps before reaching the customers:

1. Ground: local people in the first mile collect plastic bottles from the streets and landfills, to trade them for cash at the local collection centre. The bottles are then prepared and bundles and transported to recycling facilities for processing.
2. Flake: at the recycling facilities, bottles are unloaded and grinded into plastic flakes, caps and labels are removed, in this way non-PET material cannot access the following steps of the processing.
3. Yarn: fibers are spun and texturized and a more solid fiber. This is the step where recycled material takes the place of traditional one without compromising the texture.
4. Fabric: Ground to Good™ yarn is woven or knit to generate the final, unique fabric. Currently, the company has around 35 kinds of fabrics, enabling many designers to make an impact.

This careful process is possible because Thread traces and accumulates the waste material at the Country level, and then keeps an accurate database of each collector and their networks, overcoming in this way many of the barriers addressed in the previous section. Indeed, after accurately selecting its supply chain partners, the company maintains chain of custody throughout the whole value chain. By owning the material during the production process, Thread has full control and knowledge of the characteristics of the fabric it generates; it uses barcodes and tracking numbers to separate the material and checks the accuracy of data with physical visits and other forms of monitoring.

Thread does a pretty good job in engaging potential and actual customers in the stories behind the products. The company's website is enriched by appealing videos that report curiosities about the making of the products, the life of the local workers employed in the collection of plastic, and insights about the value chain activities.

The videos highlight the importance of the impact that Thread, and more in general plastic recycling has on local communities, and make potential clients feel empowered to make an actual difference for them. This concept is well expressed by the following sentence, which is reported on the company's website:

*“If we're all here to start a revolution, think of Thread as the ammunition...but with a fabulous hand feel and an even more terrific drape. **And now it's you that's making a difference.**”*

To provide another example, in the website section dedicated to the collaboration with Timberland, it is stated in a video that plastic bottles are seen as a means to a future by local communities, that have found in plastic waste collection a stable source of income that allows them to, among others, send their children to school.

Thread International strongly supports the idea that the way products are made right now is not as good as it could be, and it is time to start making things differently. In the video Thread x Timberland, the company leaves the watchers with the message that, by just putting their clothes on in the morning, they can make a difference in somebody else’s life, and that “*This is not a boot. This is change.*”

Contrary to what one would expect from a company heavily involved in recycling, in the videos Thread focuses more on the human and social impact of its operations rather than on the environmental one, aiming at creating empathy among watchers. Rather, the environmental aspect is reported in figures below the videos, like this one concerning the collaboration with Timberland.



Figure 11: Thread x Timberland, Impact (Source: threadinternational.com/collaborations/timberland)

- *4Ocean (Boca Raton, USA)*

The story behind 4Ocean started when two friends, Alex Schulze and Andrew Cooper, took a surf trip to Bali, and saw something that changed the way they looked at the ocean forever: they were devastated by the vast amount of plastic waste in the ocean and shoreline, and even more shocked by the fact that no one was doing anything about it. They saw fishermen literally pushing their boats through piles of plastics and realized that all that waste endangered not only the environment, but also the fishermen’s livelihood. They saw fishermen that, after pulling in their nets, threw the waste back into the sea and kept only the fish because, obviously, they were paid for catching seafood, not plastics. That is how they realized that they could shift the

demand from them going catching fish to go catch waste, creating a business model beneficial for them as well as for Indonesia.

When they returned from the trip, they brought this idea back with them, and founded 4Ocean in 2017, which hires fishermen to catch plastic waste instead of seafood and creates a reliable source of income for local communities that can make a living out of plastic collection.

Currently, 4Ocean is the world’s largest ocean clean-up company, cleaning the ocean and coastlines 7 days a week. Since 2017, it has carried out clean-ups operations in 27 Countries and has removed over 4,5 million pounds of trash from the ocean.

The clean-ups operations are entirely funded by the sale of their bracelets, which are sold for \$20 each and made of 100% recycled glass and plastic bottles.



Figure 12: 4Ocean Signature Bracelet (Source: 4ocean.com)

Through the ‘One Pound Pledge’, the company guarantees to its customers to remove one pound of waste within one year from the moment of purchase for each bracelet sold.

Since 4Ocean is aware that humans are not the only living beings harmed by plastic pollution, it supports organizations that fight to protect the hundreds of thousands of sea creatures and their habitats through the sale of ‘Legacy Bracelets’. Each differently coloured bracelet represents an ecosystem or species that is endangered by ocean plastic pollution and contributes to increasing awareness to protect them.



Figure 13: 4Ocean Legacy Bracelets (Source: 4ocean.com)

Indeed, the company is deeply committed to inspire and educate individuals and tries to involve them in its cause through strong advertising on social media and publishing catching content on its website.

Photos and videos portraying the clean-up operations, interviews of experts and the harmed villages, communities and marine species, all contribute to build a strong engagement from consumers. Impact sentences such as “*One ocean. One mission. Let’s end the ocean plastic crisis **together.***”, or “*Engineered by us. Funded by **you.***” make readers aware about the fact that they can actually do something about it, either by directly joining the many clean-ups as volunteers or by comfortably staying at home and just buying a bracelet.

Through its blog and accounts on Facebook, Instagram, YouTube and Twitter, the company makes sure that people stay up to date on everything about 4Ocean. It also runs Discover4Ocean, a Facebook group where ocean plastic pollution and other ocean conservation topics are discussed.

In only two years, 4Ocean has managed to create a strong community around itself and has inspired a global movement to protect the oceans. People’s support for 4Ocean is so strong that the company has recently opened three new Instagram pages (4ocean Bali, 4ocean Haiti, and 4ocean Florida) in response to the strong feedback and interest received. In this way the company promises to share more information about all the operations, teams and upgrades in these locations on a regular basis, together with local stories that “will make you feel good about what they are doing there”.

Obviously, 4Ocean is not the only one attempting to clean up the oceans. An increasing number of startups and organizations are actively taking part to this challenge, inspiring a movement to restore the world’s oceans by involving and educating people about ocean waste problems and solutions.

- *Replas (Australia)*

Replas is Australia’s leading recycled plastic manufacturer. It was born more than 20 years ago, when the two companies Australian Recycling Technologies (ART) and Repeat Plastics joined their forces to combine their expertise and manufacturing capabilities moved by their shared vision and care for the environment.

Using unique state-of-art machinery and robotics while focusing on energy efficiency, Replas reprocesses plastic waste into a range of over 200 plastic products for outdoor use such as decking, fending, furniture, fitness trails and products suitable for parks and traffic control, and it even offers the possibility to custom design to fit individual requirements.

The company is keen to highlight that recycled plastic does not need painting and maintenance since it does not split or crack and is resistant to termites, moisture and microorganisms, therefore it provides significant long-lasting advantages to buyers.



Figure 14: Furniture - Replas Recycled Plastic (Source: replas.com.au)

Replas differs from the previous two companies because, besides privates, it sells its products to public entities such as municipalities and schools. This ensures a stable demand for recycled plastic products, preventing the waste from ending up in landfills.

Moreover, Replas partners with many Australian companies, helping them to decrease their impact on the environment by making sure that their plastic waste is collected and recycled within the Country and bought back into useful and environmentally friendly products.



Figure 15: Fitness Circuit - Replas Recycled Plastic (Source: replas.com.au)

3.4 Main Findings

The three companies analysed used different ways to create a consistent and reliable demand for their products, and all three methods have been so far working. Thread International engages customers by creating empathy between them and the local communities involved in plastic collection, while 4Ocean does a similar thing but focuses on the environmental impact of its

operations. Both companies were born very recently and rely significantly on social media and interactive content to increase their visibility and stay in touch with customers. Differently, Replas has built a strong reputation in its Country over the years, which allows the company to have public institutions buy its products.

All the analysed companies acknowledge the fact that many people are interested about environmental and plastic issues and want to know what happens to plastics once collected and make use of online channels to educate and inform consumers about such issues.

Moreover, Thread International manages to overcome all the barriers related to uncertainty about the quality of the recycled plastic because it owns the material throughout the whole supply chain, therefore it is able to track and monitor the waste stream and run regular controls. Its expertise has enabled the company to build a robust vertically integrated recycling supply chain.

4. Conclusion

In order to ensure a proper implementation of circular economy initiatives, a more comprehensive approach that integrates all stakeholders by forming networks between them is required, involving governments, businesses and institutions.

Developing robust end markets in which all the opportunities and value streams are best captured can be attained not only by changing companies' business models, but also by opening up a dialogue with stakeholders and actors of each part of the value chain that can encourage new practices around the business models.

Indeed, all stakeholders are important for the achievement of a circular economy: businesses and governments play a very important role in driving consumers' choices with the products, services and information that they provide and at the same time consumers' demand motivates firms and governments to engage in sustainable practices and change the way they operate.

Governments are needed for setting goals and action plans containing strategic directions and necessary steps to accomplish them. Such plans should promote collaboration between actors along the value chain and support partnerships between public entities and privates, like it happens with Replas and Australian municipalities. This could be further facilitated through online platforms that would allow stakeholders to share and exchange ideas and information.

For what concerns the consumers' side, changing their attitudes and consumption patterns in the direction of a more circular economy could be achieved by increasing their awareness about sustainable environmental behaviours. Consumers are willing to engage in Circular Economy practices, but they are unaware of the possibilities of how to purchase second-hand, rent, lease or repair products. Point-of-sale information on product durability and reparability should be increased, since if consumers were educated, they could distinguish durable products from less durable ones at the moment of the purchase.

Above all, it should be up to governments to raise awareness about environmental issues and circular products and services options, making environmental efficient rules and ensuring their enforcement as well as encouraging innovation in this field both on the business and the consumption side.

Even though governments could construct policies that stimulate public participation, it must be noticed that decision-making process is shaped by both rational and irrational aspects and influenced by economic, cultural, political and social aspects, thus disciplines such as behavioural economics should be particularly taken into account when designing such policies.

Policy makers as well as private companies should use marketing strategies to raise consumer awareness about the benefits of circular economy practices, for instance by linking durability with high-quality and cost-saving, or they could encourage other stakeholders to implement these strategies. Such associations could push consumers' behaviour towards the purchase of such items and could modify their perception of leasing models and second-hand products as inferior to owning new items made out of virgin feedstock.

Another viable path is engaging consumers in the story of the communities and ecosystems behind the goods, like 4Ocean and Thread International do through online platforms. Indeed, digital has created plenty of opportunities for retailers to engage with customers before and after the point of sale, and as time passes and technology develops, this trend will increase even further.

For retailers adopting circular business models it is crucial to be able to tell stories to stakeholders, especially to customers: once they can engage people in the company's story it becomes way easier to inspire and involve them in circular economy practices, and to create and end market for recycled output.

But recycling faces several problems far before the recycled products reach the end market: missing coordination among the various actors of the value chain causes uncertainty about the quality of the recycled material, lowering the efficiency of the whole process, which is far from being optimized.

Similarly to what Replas does, actors could partially cope with this issue by owning the waste stream from the beginning in order to be able to trace it and monitor the features and quality of its recycling process, rather than just buy the material when it has already been recycled.

Even though this way of operating could solve problems concerning the final part of the value chain, coordination is needed from the very beginning, starting from plastic products creation, which has to be properly designed for recyclability avoiding additives and other substances that alter the material's property and make it harder to recycle. Manufacturers should also clearly provide information about the materials used to facilitate the recycle after their use. Building effective circular economy models for plastics requires taking into account not only the end life of a product or the resource efficiency aspect, but the sustainability across its whole life cycle. Only in this way plastics would make a notable contribution to a circular economy.

Moreover, Circular Economy should be addressed also under a convenience point of view: if consumers perceived recycled and durable products are convenient to them either under a price or quality aspect, they would be more willing to buy them.

I identify as a priority action to raise demand for circular economy goods starting from increasing consumer knowledge about the topic through awareness campaigns targeted to each age group and by introducing and strengthening environmental education in schools, in order to create demand at every level of society.

If there is no demand for recycled plastics and thus no financing going back to recyclers, the recycling process misses its whole point. No enterprise would build its business model based on collecting and processing trash if there is no demand for the final product. As Paulina Leung says: "it's all about the end markets. It's demand. Demand creates the pull."¹³

¹³ Paulina Leung, "Consumers, brand owners, processors all have a part in increasing recycled content." Interviewed by APR news (May 22, 2019). [online] Available: <https://plasticsrecycling.org/news-and-media/898-may-22-2019-plastics-news>

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