

# Chapter 1

## Circular Economy: An Emerging Paradigm – Concept, Principles, and Characteristics

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### **ABSTRACT**

*Humankind wastes resources in a way that is unsustainable over time, which makes it necessary and desirable to implement waste recycling policies that benefit all of humanity. The arrival of the circular economy is strengthening the environmental awareness of the population as well as more efficient use of scarce resources on the planet. In addition to the circular economy, this chapter briefly analyzes the different models that currently exist to combat the deterioration of the environment, since it is the responsibility of current generations to leave a better world for future generations.*

### **INTRODUCTION**

According to the World Bank (2012), each year, 1.3 billion tons of garbage are produced by 3 billion urban residents, which uses 54 percent of the world's delivered energy, especially in energy-intensive industries such as petrochemicals, cement, metals, and paper (United States of America Energy Information Administration, 2016). Besides, each year, 322 million tons of plastic, 240 million tons of paper and 59 million tons of aluminum are produced in the world (FAO, 2017; World Aluminum, 2016), much of which goes to export markets and is not recycled (Plastics Europe, 2016).

This strong waste of resources is unsustainable over time, which makes it necessary and desirable to implement waste recycling policies, which benefits all of humanity. In this sense, the arrival of the circular economy is strengthening the environmental awareness of the population, as well as the more efficient use of scarce resources.

As a result, circular models could help nations raise with resources already available in their regions. This may imply a decrease in global trade, yet the 140 million people joining the middle class each year

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promise progress in trade (Kharas, 2017). The circular economy is a reply to the aspiration for sustainable growth in the context of the growing pressure of production, mass distribution, and consumption on the limited planet's scarce economic resources. Until now, the economy has mainly operated on a 'take-make-dispose' model – a linear model where every product is bound to reach its 'end of life' (European Commission, 2014), to be rejected and thrown away after it.

With the final scope of designing product circularity, business is in the driver's seat in the changeover to a circular economy. Short product lifetimes have been a key tactic for many companies in the past, promoting frequent advancements to adapt the cleanest technologies in the market. Now, a business can hold opportunities to extend product lifetimes and create competitive and sustainable products that will last for a long time to benefit new generations.

The objective of this chapter is to analyze what is understood by the circular economy, as well as to compare it with other similar concepts that also seek environmental sustainability. All these facts will give us foot to analyze its principles and characteristics.

## **A NEW PARADIGM?**

The circular economy is understood as “an economic system that represents a change of paradigm in the way that human society is interrelated with nature and aims to prevent the depletion of resources, close energy and materials loops, and facilitate sustainable development through its implementation at the micro(enterprises and consumers), meso (economic agents integrated in symbiosis) and macro (city, regions, and governments) levels. Attaining this circular model requires cyclical and regenerative environmental innovations in the way society legislates, produces, and consumes” (Prieto-Sandoval et al., 2018, p. 610). For the impact to be effective, it must be integral, with the union of the macro, meso, and micro aspects of the circularity. This triple union is driven by technology and by the social awareness of the need to recycle, which must be done since childhood.

From the definition of circular economy, six components emerge: a) the recirculation of resources and energy; b) the minimization of demand for resources; c) the recovery of value from waste, d) a multi-level approach, e) its importance as a path to achieve sustainable development, and f) its close relationship with the way society innovates (Prieto-Sandoval, Ormazabal, Jaca, and Viles, 2018). The first component is entropy as an extensive property of a thermodynamic system, and more specifically, the second principle of thermodynamics so that the system is in equilibrium that is achieved with the transformation of energy as it is recycled following a circular economy scheme. Hence, it is so important to achieve the recovery of value from waste by following a multi-level approach to achieve sustainable development through innovation. This process of innovation allows the use of new recycling systems that are more efficient in the use of resources to have a lower environmental deterioration where the supply chain has a key role to play.

A multi-loop supply chain system complements the second principle of thermodynamics. In fact, Multi-loop supply chain system activities broaden the economic benefits achieved by the society and rarely link the activities to economic benefits, especially mostly dealt with optimization of resource use by minimizing waste, emissions, energy leakage, and resource input (Tseng et al., 2020). To avoid energy leakage is key to have sustainable and highly effective production systems to benefit both economies and societies. This loss of energy, especially in transport, is at least partially mitigated using superconduc-

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