

# Going Full Circle: How to Implement Circular Economy

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# Abstract

In society's quest for progress in every single aspect of life, humanity has clearly pushed the boundaries of what can be exploited out of nature past the limit in the last few years, which has resulted in severe climate change and scarcity of resources. To avoid facing a catastrophic crisis, this thesis discusses the logic and philosophic shortcomings of our current linear economy in relation with both philosophical thinkers and ideas such as the Lockean proviso or John Rawls' politic theory, and tools and thought processes used in the business world to talk about economics such as Maslow's Hierarchy of Needs or game theory. The first chapter of this thesis discusses the reasons to abandon capitalism and the current linear economy models and engages in metaphysical thought of the concept of economics to build the minimum framework of what is expected of an economic model. The second chapter addresses in depth the model of linear economy and why it fails to fulfill the minimum requirements of a desirable economic model. The last chapter talks about circular economy as the logical evolution and alternative to linear economy models. It builds a model proposed as a possible future of a global circular economy implementation. It explains how circular economy fulfills with the minimum requirements of a desirable economic model and introduces the concepts of duality of property and the attribution of life and death to objects that hold sentimental value as necessary to reach that goal.

# Introduction: The Proposal of a Crisis

The thesis you are about to read will have one inevitable consequence in economics. It is often believed that global adjustments or changes in economics, especially those that happen on a large scale, always involve a situation of crisis while every affected aspect and agent adapts to it. However, this is not necessarily true. It is true that only a crisis can produce real change, as Milton Friedman once said,<sup>1</sup> but not all crises produce significant change as an outcome of finding a solution to it. There are moments in which the actions and decisions to get out of crises are reactionary, compliant, and do not build new foundations to truly exit the crisis as a better society with an improved system. Such is the case of the 2008 crisis, in which the financial measures taken to move forwards from it and ensure that it would not happen again were too superficial, and ultimately have failed recently, as demonstrated by the actions and hardships that Silicon Valley Bank and Signature Bank have been through recently, needing to be rescued by the federal government.<sup>2</sup> Other times, the changes are proactive, and the results do make a difference in the world moving forward besides the solution of the crises themselves.

In the current state of our environment, we find ourselves at a crossroads between two different approaches to two potential crises. To a certain extent, the actions we take regarding our understanding of economics and environmentalism could determine the

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<sup>1</sup> Sheri Berman, "Crises Only Sometimes Lead to Change. Here's Why.," *Foreign Policy* (blog), July 4, 2020, <https://foreignpolicy.com/2020/07/04/coronavirus-crisis-turning-point-change/>.

<sup>2</sup> Jim Tankersley, "How Silicon Valley Bank's Failure Could Have Spread Far and Wide," *The New York Times*, April 13, 2023, sec. U.S., <https://www.nytimes.com/2023/04/13/us/politics/silicon-valley-bank-widespread-failure.html>.

kind of crisis we get in the future, because either by our purposeful transformation of society or by what is coming if we do not change, the event of a crisis is inevitable. We can either stick with our current linear economy, continue going down the current path that we are going as a society and have to deal with a catastrophic climatic and scarcity crisis that we will have to react to, or we can take matters into our own hands and implement circular economy at a global scale, and provoke a crisis that will be constructive in nature and will make us a better, more sustainable society. I advocate for the latter of these situations in this thesis, a proactive and constructive kind of crisis instead of a disruptive one with lower potential of improvement for the society.

Chapter I addresses all the reasons why we must abandon capitalism and linear economy. While over time they have provided us with great value and they have sped up dramatically our progress, this has only been achieved at the expense of our environment. On top of that, they still have not been able to quite grasp an efficient competitive model at all its levels, leaving us with inefficiencies of competition that hurt the markets' ability to provide value to the client even though the competitors are acting reasonably within the rules of capitalism. By examining different material from a philosophical and economic standpoint, this chapter sets the benchmarks of what we expect our economic models to achieve in basic terms. Laying all these out, this chapter proves that the benchmarks are not met by capitalism or linear economy models in general, therefore the only reasonable consequence of the premises found is that we must change our economic models from linear to circular economy models.

Chapter II dives further into the specifics of linear economy models, breaking them down into its different steps: extraction, refining, manufacture, assembly,

consumption, and waste management. It examines each of these steps in order to break down their impact on the environment, specifically the problems of climate change and scarcity of resources. After explaining all the steps regarding linear economy, it breaks down how it fails to fulfill the red lines that establish what we want from an economic system.

Chapter III presents the alternative of circular economy, explaining the main changes in the concept as opposed to circular economy. The main idea is to build an economy that integrates itself within nature instead of taking advantage of it blindly. In order to do so, instead of the wrong popular assumption that this is some extreme form of recycling, it is established that there is much more to it and that recycling is actually a step to skip as well when it comes to the circularity of products and materials. The idea of this chapter is to build a concrete scenario in which circular economy is built not as an abstract collection of ideas, but as a system that can be put into practice and fulfills all of the red lines that linear economy cannot operate under, while also addressing common criticisms to the concept of circular economy from a technical, political, and ethical perspective.

# Chapter I: Foundational Criteria for the Judgement Between Linear and Circular Economy Models

Economic models come in all kinds of forms and spectrums. They can tend to libertarian models with more individual financial freedom, or more authoritative models with more restrictions and regulations. There is also a spectrum regarding the ownership of companies and means of production, from primarily privately owned to publicly owned. These and many other aspects make the discussion of economic models very complicated because it can easily be corrupted by other areas of study that have little to do with the field of economics. As an example, it may be worth discussing politics to explain advantages and disadvantages of different government models, but that has little to add to the field of economics. There are communist capitalistic democracies and dictatorships, and capitalistic monarchies and democracies with very different focuses on the economy. The scope of this thesis and chapter will not directly cover these kinds of ideas, for I believe that even if they are important, they can shift the focus to what really is important economically wise, which is the management of resources and innovation of products and processes.

It turns out that, for as long as human civilizations have had elaborated systems of production, humanity has followed the same model, regardless of whether our perception of the system qualifies as communist or capitalist. This is what is known as the linear economy model. Even though the specifics of how linear economy works will not yet be explained in this chapter, the idea of this concept as a take-make-use-waste model will be challenged.



In this chapter, I explain how we have benefited from the capitalistic system, which has been responsible for the optimization in the efficiency of the linear economy models, and how it is regardless a flawed model that cannot be sustainable long-term. In doing so, I present different philosophical ideas, as well as ideas that are not strictly philosophical but can be discussed in philosophical terms, such as Maslow's Hierarchy of Needs or game theory. The argument often used to justify the need for change from a linear economy to a circular economy is usually based on the urgency of the problem of climate change and environmentalism. While I believe that is sufficient reason for countries to heavily promote these changes, I intend to explain why this is also a sound financial decision that companies should be making themselves without the intervention of the government.

By the end of this chapter, I will have addressed exactly why there must be a significant change in the way we produce products of all kinds, and I will have highlighted certain aspects of the basic expectations that we all have regarding economics. This set of ideas will be the pivotal aspects of the new economic model, which will inevitably be a form of circular economy.

### **Changes in the Concept of Crisis**

The fact that capitalism has been essential for the development of human societies during the Modern and Contemporary eras of history is something that cannot be doubted. It has brought development to the point where our definition of crisis has changed significantly compared to that of the societies before the global imposition of this economic model. Our expectations of life now have been raised dramatically from

the Ancient Rome civilizations, for example, and it shows very evidently in how we speak about periods of crisis throughout history compared to what we call crisis in modern times.

When we think of a crisis in the Ancient World, we think of catastrophic events that ended civilizations or at least put them in serious danger, such as the one that led to the end of the Roman Empire in 476. We might also think of the recently discovered volcano eruption in Iceland in 536 that dimmed the Sun for more than a year and made crops fail, provoking famine in Ireland, Scandinavia, Mesopotamia and China, making medieval historian Michael McCormick refer to this year as the worst to be alive.<sup>3</sup> Other examples of catastrophic events that jeopardized human society came from pandemics such as the Antonine Plague that is believed to have killed 1-2% of the population of the Roman Empire<sup>4</sup> and is believed by some to be the beginning of the end of the Roman Empire<sup>5</sup>, or the Black Death that killed a quarter of the European population between 1348 and 1350 and collapsed the city to the point where “the corpses and the near corpses were thrown into carts and dumped indiscriminately into huge pits outside the town walls.”<sup>6</sup> We picture, in our minds, apocalyptic-like scenarios, often involving death of many as a result of it. However, it does not even cross our mind to think of lesser scenarios such as the economic crisis of 33 CE in the Roman Empire, caused by a law requiring creditors to invest part of their capital in Italian terrain to mark the uniqueness

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<sup>3</sup> “Why 536 Was ‘the Worst Year to Be Alive’,” accessed February 9, 2023, <https://www.science.org/content/article/why-536-was-worst-year-be-alive>.

<sup>4</sup> Willem Jongman, “Gibbon Was Right: The Decline and Fall of the Roman Economy,” in *Crises and the Roman Empire: Proceedings of the Seventh Workshop of the International Network Impact of Empire, Nijmegen, June 20-24, 2006*, ed. Impact of Empire (Organization) et al., Impact of Empire, v. 7 (Leiden ; Boston: Brill, 2007), 209.

<sup>5</sup> Willem Jongman, “Gibbon Was Right: The Decline and Fall of the Roman Economy,” 195.

<sup>6</sup> William L. Langer, “The Black Death,” *Scientific American* 210, no. 2 (1964): 117.

of the area within the empire, appealing to the foundation of the entire empire on Italian agriculture.<sup>7</sup> As a matter of fact, this crisis seems to only be brought up nowadays because the measures that the then-emperor Tiberius took to solve the crisis were very similar in principle to the Troubled Asset Relief Program that Mario Draghi launched to stabilize the euro back in the 2008 crisis,<sup>8</sup> which we undoubtedly refer to as a crisis in our current mindset. I believe this to be a symptom of how much the living conditions have improved since then. Our standard of crisis is proportionally inverse to our standard of living, and with the rise of the latter, the former seems to lower.

### **Advances During the Early Stages of Capitalism**

If this is the case, we seem to start to take a leap with the arrival of the Industrial Revolution. The arrival and improvement of the steam engine was vital in the massive expansion of cities, industries, and many different types of infrastructure.<sup>9</sup> There are many examples of industries that during the First Industrial Revolution (1750-1840) grew substantially, and in some cases became the engines of a country's economy. One of the most notorious ones is the textile industry. Its contribution to the British economic development was one of the reasons why they rose as the leading country during this period of the Revolution. The invention of Crompton's mule for spinning cotton significantly improved the productivity of the workers.<sup>10</sup> One worker at a machine with 100 spindles on it could spin 100 threads of cotton more than 100 workers could on the

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<sup>7</sup> "The Financial Crisis, Then and Now: Ancient Rome and 2008 CE," December 10, 2018, <https://epicenter.wcfia.harvard.edu/blog/financial-crisis-then-and-now>.

<sup>8</sup> "The Financial Crisis, Then and Now."

<sup>9</sup> Haradhan Kumar Mohajan, "The First Industrial Revolution: Creation of a New Global Human Era," *Journal of Social Sciences and Humanities* 5, no. 4 (May 30, 2019): 2.

<sup>10</sup> Mohajan, "The First Industrial Revolution: Creation of a New Global Human Era," 7.

old spinning wheels.<sup>11</sup> Prior to the development in the textile industry, each manufacturer seemed to work differently, and their productivity largely varied throughout the year.<sup>12</sup> After the development of this industry the production was much more efficient and stable, to the point that by 1900 40% of the world's production of cotton goods was produced within 30 miles of Manchester.<sup>13</sup> The growth of the iron and steel industry in Britain was also significant. Between 1750 and 1805, iron production in England multiplied by almost 10 times<sup>14</sup> and they were able to not depend on their imports from Sweden, from whom they were importing over 50% of their total iron exports.<sup>15</sup> Later on, after a peak 60,000 tons of steel bar imports from both Sweden and Russia, new coal-based technologies denied Russian and Swedish producers access to the British market,<sup>16</sup> therefore helping Great Britain in transforming from dependent buyers to self-sufficient manufacturers.

Transportation also transformed as “the backbone of any economic, culture, social and industrial development.”<sup>17</sup> Affected directly by James Watt's steam engine, it was used in both road and water transportation propelling cars, locomotives, and boats. It allowed for trade to happen between places that had very little means of contacting each other otherwise, although later on the car manufacturing industry would get its own boom with the arrival of Henry Ford's assembly line, which really revolutionized transportation

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<sup>11</sup> Mohajan, “The First Industrial Revolution: Creation of a New Global Human Era,” 7.

<sup>12</sup> Jane Humphries and Benjamin Schneider, “Spinning the Industrial Revolution,” *Economic History Review* 72, no. 1 (February 2019): 136, <https://doi.org/10.1111/ehr.12693>.

<sup>13</sup> Mohajan, “The First Industrial Revolution: Creation of a New Global Human Era,” 7.

<sup>14</sup> Mohajan, “The First Industrial Revolution: Creation of a New Global Human Era,” 8.

<sup>15</sup> C. Evans, O. Jackson, and G. Rydén, “Baltic Iron and the British Iron Industry in the Eighteenth Century,” *Economic History Review* 55, no. 4 (November 2002): 644, <https://doi.org/10.1111/1468-0289.00235>.

<sup>16</sup> Evans, Jackson, and Rydén, “Baltic Iron and the British Iron Industry in the Eighteenth Century,” 645.

<sup>17</sup> Mohajan, “The First Industrial Revolution: Creation of a New Global Human Era,” 11.

of individuals and allowed him to popularize mass production and adjust to changes in demand by using multiple lines that in some cases were temporary and only used for 2 or 3 weeks at a time.<sup>18</sup> Lastly, agriculture also changed for the better in Britain. English farmers benefited from both new inventions that contained iron parts, such as the seed drill, and from more productive seeds and harvesting methods like rotating crop cultivation. Animal specialization in Britain had significantly improved, which allowed for breeders to concentrate on either improving animals for work or for the production of milk or meat, which translated in a far larger farm output of their livestock compared to the likes of the rest of European countries.<sup>19</sup> The average weight for lambs, for example, increased from 18 to 50 pounds between 1700 and 1786.<sup>20</sup>

All these advances translated into very significant growth. Graphics show that the British population grew exponentially between 1760 and 1810.<sup>21</sup> The total population in Britain was 8.3 million in 1801 and by 1901 it had grown up to 32.5 million. Europe followed suit with a similar trend, the population increased from roughly 100 million in 1700 to 400 million by 1900. The main factors in this dramatic rise are the rise in nutritional status and the improvements in medical science, the sanitary system, and economic development that had transformed the standard of living.<sup>22</sup> This economic

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<sup>18</sup> James M. Wilson, "Henry Ford vs. Assembly Line Balancing," *International Journal of Production Research* 52, no. 3 (February 2014): 761, <https://doi.org/10.1080/00207543.2013.836616>.

<sup>19</sup> James Simpson, "European Farmers and the British 'Agricultural Revolution,'" in *Exceptionalism and Industrialisation: Britain and Its European Rivals, 1688–1815* (Cambridge University Press, 2004), 75–76, <https://web.s.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHhuYV9fNTI5MzQyX19BTg2?sid=1d024935-c433-4922-98a9-77a2c64cc403@redis&vid=0&format=EB&rid=1>.

<sup>20</sup> Mohajan, "The First Industrial Revolution: Creation of a New Global Human Era," 11.

<sup>21</sup> John Komlos, "Nutrition, Population Growth, and the Industrial Revolution in England," *Social Science History* 14, no. 1 (1990): 71, <https://doi.org/10.2307/1171364>.

<sup>22</sup> Mohajan, "The First Industrial Revolution: Creation of a New Global Human Era," 10; Komlos, "Nutrition, Population Growth, and the Industrial Revolution in England," 72–73.

growth can be shown by the development of working class wages that, although they did not rise nearly as much and as steady as the income of the rich means of production owners, they were enough to sustain the huge demographic growth mentioned earlier when in other eras all those people would have perished, and allowed for sufficient formation of the workers to develop class conscience that produced unprecedented social protest and conflict in the shape of anticapitalistic critique.<sup>23</sup> Marx refers to this as the war on class struggle, and becomes a key element to his famous works *Das Kapital* and *The Communist Manifesto*.

The concepts of class struggle, alienation, social oppression, and communism that Marx raised are meant to express the social and economic crisis of his time. People could barely afford anything other than food and rent for their families in the lower class, and Marx observed that they were essential in the operation of factories of their time, yet they were not reaping most of the economic benefits of the production and selling of what was produced. While it is a concerning crisis, there is a quite significant difference between barely having enough to live, and not having enough to eat, or having events of mass death such as the case with the Black Death or the famines in Ancient Egypt. What happened back then is that life itself was in danger for many, as opposed to Marx's crisis in which the focus is on the poor quality of life of the lower social class. Two different crises with very valid reasons that affect many people negatively, but not on the same level of urgency or impact.

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<sup>23</sup> Mohajan, "The First Industrial Revolution: Creation of a New Global Human Era," 10; Maxine Berg and Pat Hudson, "Rehabilitating the Industrial Revolution," *Economic History Review* 45, no. 1 (February 1992): 42–43, <https://doi.org/10.2307/2598327>.

## **Maslow's Hierarchy of Needs**

American psychologist Abraham Maslow brings up a Hierarchy of Needs, which is a scheme of how to rank the needs in order of what motivates humans first to take action on. If we look at Figure 1, we can see that the physiological needs are the most immediate needs associated with human survival, such as food or water. Above this level, we find safety needs, belonging and love needs, esteem needs, and self-actualization needs. Maslow argues that, even though the pyramid diagram and his early statements suggest that the order of satisfaction of needs must be rigid, meaning that the basic needs must be completely fulfilled before being able to fulfill the rest of the needs, there can be needs that start to be addressed before the previous ones are completely satisfied, or needs that are motivated by various levels of this division.<sup>24</sup> However, physiological needs still need to be reasonably met in order to let them go away from our main attention and aim for safety needs. It would make no sense to want security of the physiological need for food, to guarantee that I never starve, if I cannot even find food in the first place.

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<sup>24</sup> "Maslow's Hierarchy of Needs - Simply Psychology," November 3, 2022, <https://simplypsychology.org/maslow.html>.

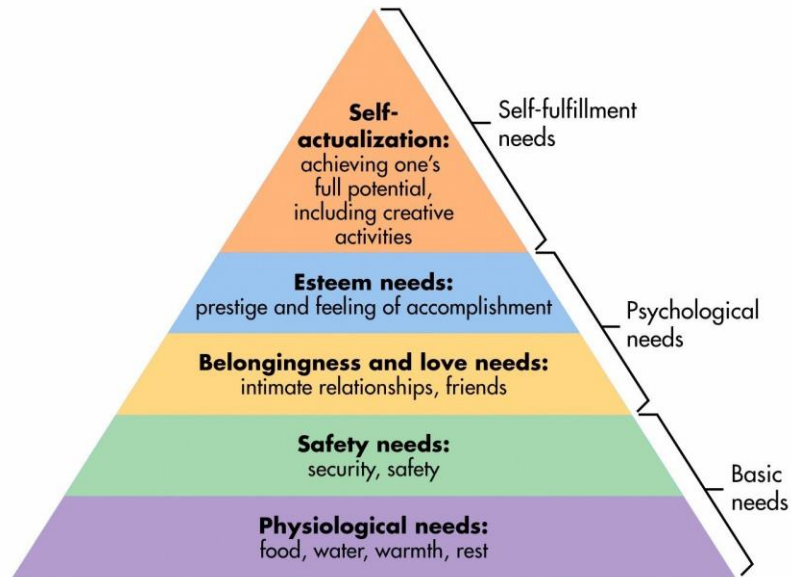


Fig. 1: Maslow's Hierarchy of Needs.<sup>25</sup>

As much as Maslow's Hierarchy of Needs is usually applied at an individual level, I believe that it can be used to explain the differences between the situations in Ancient Egypt or the Black Death compared to the 1850s when Marxist theory was introduced to the world. The Ancient Egypt and the Black Death were crises that affected physiological needs such as food or health in so far as not being mortally sick. Food was not a given in Ancient Egypt when the Nile had dry years, and during the Black Death one would be dead the moment they catch the disease, which was of quite efficient spread. In contrast, Marx's ideas are more concerned with safety needs, and especially belongings, love, and esteem needs in the case of alienation and social class oppression. To some extent, the reason why Marx could spark a revolution based on these needs is because more basic needs are already covered and are not even in their scope of needs anymore in a general sense. Kids that work in factories need an education and a chance to

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<sup>25</sup> "Maslow's Hierarchy of Needs - Simply Psychology."



have a better life than their parents because their need for sufficient food to survive is already sufficiently covered, meaning that most of the members of the society have said covered needed even if there are specific situations in which this is not the case. If economic or demographic advancements are not enough to prove the extent of the progress made through capitalism, then surely the understanding of crises changing in accordance with our needs should prove it beyond any doubts.

### **Correlation Between the Fall of Ancient Civilizations and Nature**

For all of these advances in such a short time historically speaking, one may be inclined to believe that capitalism is a system that has potential to be developed into one that can serve us for years to come. However, it has proved to have fundamental flaws that suggest that its shortcomings go beyond people's occasional wrongful or irrational actions and pose a threat to our current civilization. Although most of these explanations have to do with our assumptions of how capitalism works, and they involve mathematics that needs to be introduced and explained in the first place before I make use of it to explain the issues at stake, I can already come forward with the themes that they will touch on, none other than climate change and sustainability.

Throughout the history of human civilization, many technological challenges have been overcome, such as distance between faraway civilizations or growing American crops in European soil. Still, one way or another, climate and natural resources have dictated the rise and fall of civilizations. In Ancient Egypt, pyramid construction during the Old Kingdom coincided with bountiful Nile floods.<sup>26</sup> On the other hand, severe dry

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<sup>26</sup> Mohamed Hamdan et al., "Climate and Collapse of Egyptian Old Kingdom: A Geoarchaeological Approach," in *Proceedings of the Workshop "Italian Days in Aswan,"* 2015, 39.

periods that damaged the crops and the soil that they grew on were very influential in its fall. “The collapse of centralized Egyptian government about 4200 cal. BP, coincides with reduced Nile flood discharge, invasion of the Nile Valley by dune sand, and possible degradation of the Delta floodplain as revealed by proxy sedimentological data.”<sup>27</sup> The fall of Ancient Rome can be explained under a similar light of dependency of nature, in this specific case of natural resources. The lack of precious metal content of the coinage of the years prior to its official fall suggests a lack of said material in the Roman mines of the time. Suddenly, there was not an equal amount of tangible material within the coins that explained why were worth the same as those that had a higher concentration of precious metals in it. “This means that a coin of Gallienus (for example) that was perceived or known to have less silver than a coin of Nero did not have the same buying power, despite the same face-value.”<sup>28</sup> Only the reorganization of the entire currency system around gold saved the economy from constant rampaging inflation,<sup>29</sup> but the discredit to the Empire became evident and one of the reasons why Barbarians attacked from the border. Both Ancient Egypt and Ancient Rome are past examples that human civilizations do not beat climate change or lack of natural resources on the long run.

Likewise, we have not been able to beat climate change and lack of resources in the present. There are plenty of environmental metrics that suggest the damage that we have been inflicting on our own planet is reaching a point of no return that could have very serious consequences in the future. These consequences are unavoidable unless

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<sup>27</sup> Hamdan et al., “Climate and Collapse of Egyptian Old Kingdom,” 45.

<sup>28</sup> Stuart Robertson, “The Crisis of the 3rd Century A.D.: Wage Increases and Inflation in Roman Egypt,” *Durham E-Theses*, 2014, 103.

<sup>29</sup> Kyle Harper, “The Environmental Fall of the Roman Empire,” *Daedalus* 145, no. 2 (April 1, 2016): 109, [https://doi.org/10.1162/DAED\\_a\\_00380](https://doi.org/10.1162/DAED_a_00380).

action is taken soon to reduce our impact on the environment. The CO<sub>2</sub> particles in the atmosphere are the highest they have ever been in human history, which has increased the average temperature of the planet in roughly 1° C since the Industrial Revolution.<sup>30</sup> This has already started impacting different areas of the world. The poles are melting as a consequence of this increase in temperatures at an accelerated rate, and it is expected that by 2035 there will not be any ice left during the summer months in the Arctic.<sup>31</sup> The sea level is also increasing very fast as a consequence of climate change. In the near future, this could mean that many of the major cities in the world, as well as some islands, will be underwater if the sea levels keep rising at this rate.<sup>32</sup> In fact, the UN are already using the term “climate refugees” to refer to all those who will be displaced from where they live as a direct cause of climate change.<sup>33</sup> 9% of all the deaths are already caused by the contamination of the atmosphere.<sup>34</sup> These metrics show that we are simply not going to overcome nature, and that we must stop abusing it for the sake of our economy if we are to avoid the worst consequences.

We find ourselves in a similar situation to that of the Ancient Egypt or the Roman Empire right before their civilizations collapsed. The climate crisis has the potential to be of biblical proportions, enough to wipe out our current civilization in a similar fashion

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<sup>30</sup> “Climate Change: Global Temperature | NOAA Climate.gov,” accessed March 18, 2023, <http://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>.

<sup>31</sup> Alejandra Borunda, “Arctic Summer Sea Ice Could Be Gone by as Early as 2035,” *Science*, August 13, 2020, <https://www.nationalgeographic.com/science/article/arctic-summer-sea-ice-could-be-gone-by-2035>.

<sup>32</sup> Ricardo Domingues et al., “What Caused the Accelerated Sea Level Changes Along the U.S. East Coast During 2010–2015?,” *Geophysical Research Letters* 45, no. 24 (December 28, 2018), <https://doi.org/10.1029/2018GL081183>.

<sup>33</sup> Abraham Lustgarten, “The Great Climate Migration Has Begun,” *The New York Times*, July 23, 2020, sec. Magazine, <https://www.nytimes.com/interactive/2020/07/23/magazine/climate-migration.html>.

<sup>34</sup> Hannah Ritchie and Max Roser, “Air Pollution,” *Our World in Data*, April 17, 2017, <https://ourworldindata.org/air-pollution>.

than it happened earlier in history, with the aggravated detail that it is possible that our damaging of the global climate could also make it hard for new civilizations to prosper in the following years to come if effective action is not taken against this possible outcome. We have been facing mild crises through this time in comparison to the Black Death or the famine in Ancient Egypt, but what comes is nothing short of what would have been called crisis even in ancient times. We are in danger of repeating history once again as a civilization that made incredible advances during its time but fell due to climatic conditions heavily affecting their human activities if we fail to come up with new approaches that are more respectful with nature.

### **Introduction of the Concept of Circular Economy**

An approach that is believed to have great impact in reducing human activity's carbon footprint suggests that the concept of manufacturing must be reinvented altogether. Circular economy is a revolutionary production system that breaks with the way in which humans have been producing everything since the Industrial Revolution. It is based on the idea that, to maintain economic systems long term and avoid harming nature, economic systems must function within nature and imitate it. Its main principle, in philosophical terms, is the Lockean proviso, which says that when one makes use of elements of public property, one must make sure there is left enough and as good of whatever resource is used that others are not impeded or restricted of its use.<sup>35</sup> Circular economy models fulfill the Lockean proviso by eliminating the concept of waste, which involves a constant reintroduction of the products and materials into the production

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<sup>35</sup> John Locke, *Second Treatise Of Government* (Project Gutenberg, 2010), chap. V, section 33, <https://www.gutenberg.org/files/7370/7370-h/7370-h.htm>.

process. The Ellen MacArthur Foundation, which works on promoting the application of circular economy around the globe, says that “circular economy gives us the tools to tackle climate change and biodiversity loss together.”<sup>36</sup> Given that the idea of needing to change from an environmental perspective has been explained in this thesis already, and also by many organizations across the world, and yet there is a lack of consensus regarding how to change the way we manufacture the products that give our businesses and our economy as a whole a reason to exist. I will attempt to use business analytic thought to argue that change is in fact necessary not only from an environmental point of view, but also from an economic point of view, by analyzing what is involved in the decision-making process of the economic agents across the economic spectrum.

### **Basic Notions of Game Theory and Nash’s Equilibrium**

Game theory is a discipline that studies the decisions that different parties make in strategic situations in which the decisions that one makes influence the decisions of the other or others involved. In business, game theory is utilized in strategic management as a tool that helps understand competition between rival companies and can be used to predict what actions a company might take depending on what another company does. Like in a game of chess, strategies are not predetermined right away. Instead, they adapt to the one of the opponents. When analyzing a decision in game theory, there are three parts that are necessary to any game. There needs to be a set of players or participants, different actions or moves that the players can make, and payoffs that the players can

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<sup>36</sup> Ellen MacArthur Foundation, “Circular Economy Introduction - Overview,” accessed November 22, 2021, <https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview>.

receive, either positive or negative.<sup>37</sup> Each player or participants will choose their actions looking for their maximum payoff, what is best for themselves, and it is assumed that the other player will do the same in relation to their situation and actions. Rationality is also assumed in this game, meaning that impulsive decisions that lead to mistakes and loss would not happen. The idea is that all participants try to guess each other's strategies before making a move and account for that to achieve maximum gain.

In some ways this model seems to be very in line with how we think of competition in a capitalistic economy. Our actions and decisions influence others' and vice versa, and everyone is at the end of the day looking for the best for themselves, their families, or their loved ones. One would think, then, that in a capitalistic economy it is competition that supports it, and within the parameters of game theory, that everything can be reduced to competition against different agents. However, this is not always the case at this level even if it is assumed that it is from the outside when one looks at some specific scenarios in detail.

John Nash, one of the most influential mathematicians in the field of game theory, discovered that there are certain situations in which singularities happen from a mathematical standpoint. A situation like this is called Nash's equilibrium, and it means that given the agent's decisions and the possible payoffs they can get, everyone involved is content with their decision and would not change it after everyone has chosen their actions. Nash's equilibriums are on paper very stable because, in order for the game to

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<sup>37</sup> James D. Miller, *Game Theory at Work: How to Use Game Theory to Outthink and Outmaneuver Your Competition* (New York: McGraw-Hill, 2003), 4.

change, there must be a change on either the payoffs or the actions that the participants can choose from because there is a perfect strategy for everyone to counter each other.

	PLAYER 2		
		X	Y
PLAYER 1	A	(1,1) E	(0,0)
	B	(0,0)	(5,5) E

Fig. 2: Practical explanation of Nash’s Equilibrium in game theory.<sup>38</sup>

An example of a situation of Nash’s equilibrium can be found on Figure 1. Player 1 gets to choose between actions A and B, and Player 2 gets to choose between X and Y. With the payoffs expressed by the numbers shown, we can follow the thought process of game theory without having to deal with all the hard mathematics that build these concepts and allow us to understand the practicality of this methodology. In this situation, it is obvious that the combination of actions BY are a point of Nash’s equilibrium because it is the maximum payoff for both of them, but in this scenario AX would also be a Nash’s equilibrium. Player 1, supposing that Player 2 will choose X, maximizes the benefit of his possibilities by choosing A, and the same goes for Player 2 regarding Player 1’s actions. Nash’s equilibriums can be multiple in games, and they are not necessarily optimal. If players 1 and 2 were stuck in a AX equilibrium, that would not be the optimal outcome for both, so they should convince each other to change their actions

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<sup>38</sup> Miller, *Game Theory at Work*, 104.

simultaneously to BY so that they stay in a stable Nash's equilibrium that also guarantees maximum payoff.

When Nash's equilibriums are found in a context of capitalistic economy, they can often be related to stable market situations, since all agents are satisfied with their actions in comparison to what other players can do. As long as the market's external factors remain unchanged, or change but not in a significant way, the agents will stick to what they have been doing up to that point, assuming rationality. However, a stable market does not imply that the market is being the most efficient it can be for all players because there can be inefficient equilibriums or even equilibriums that damage the agents but still are the result of rational decisions that would not make sense to change.

An example of Nash's equilibriums that make the players fall into ruin is a situation often referred to as the Prisoner's Dilemma. In this scenario, two murderers (A and B) are arrested for the execution of a number of people. The police finds unregistered weapons in both of their homes, but they do not have enough to charge either one of murder, so they isolate them from each other and they offer them the possibility of confessing. If one of them confesses, they are set free while the other is charged as a serial killer and is given the death penalty. If both of them confess, they both get charged, but instead of death penalty they get life in prison. If neither of them confess, they are charged only for the unregistered weapons and get only one year each in prison.



	B		
		CONFESS	NOT CONFESS
A	CONFESS	(Life, Life) E	(Free, Death)
	NOT CONFESS	(Death, Free)	(1 year, 1 year)

Fig. 3: The Prisoner's Dilemma.<sup>39</sup>

It may be intuitive when given the options on the table to choose to remain silent, given that if both of the prisoners stay silent, they both get a year only and avoid death. However, since they cannot talk to each other, they cannot trust that if they remain silent, the other one will do the same. Even if they had agreed to do this before being caught, it is just the word of a murderer, so can either one of them really trust each other despite the promises made beforehand? Assuming that life in prison is better than death, there is a clearly dominant strategy, a strategy that should be picked regardless of what the other player does, that forces both of them to confess because they would regret not confessing if the other one does it, for they would be killed. Even if A is convinced that B will not confess, he should still confess because then he would be free instead of not confessing and spending one year in prison. But, since both A and B will confess, as it is the only stable outcome as the Nash's equilibrium, they both end up getting a bad outcome because it was the only way these two rational, self-interested murderers could act.

Thankfully for our cold-hearted murderers that would have no remorse ratting each other out and being at least partially responsible for the death of the other, let alone the rest of the people they are being judged for, the Mafia is the key to overcome their

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<sup>39</sup> Miller, *Game Theory at Work*, 117.

dilemma. Membership to a corporation that punishes confessing very harshly clears the way to a more advantageous outcome for both A and B. Making the act of confession be equivalent to death, whether it is by the Mafia or the law is irrelevant to the murderers. To be even more certain of the actions that A and B will take, the Mafia can punish confession in an even more harsh way than just death to avoid any arbitrary confession provoked by a sudden burst of conscience by either A or B.

	B		
A		CONFESS	NOT CONFESS
	CONFESS	(Death, Death)	(Death, Death)
	NOT CONFESS	(Death, Death)	(1 year, 1 year) E

Fig. 4: The Mafia solves Prisoner's Dilemma<sup>40</sup>

	B		
A		CONFESS	NOT CONFESS
	CONFESS	(Death of A and his family, Death of B and his family)	(Death of A and his family, Death)
	NOT CONFESS	(Death, Death of B and his family)	(1 year, 1 year) E

Fig. 5: The Mafia makes sure they solved Prisoner's Dilemma

Nash's equilibriums represent stable sets of strategies for different players in a game, but what they mean in practicality and whether they are good or bad, that depends on the nature of the game itself. When it comes to the game of economics, and capitalistic

<sup>40</sup> Miller, *Game Theory at Work*, 119.

economics at that, I believe that Nash's equilibriums can be signs of inefficiencies in competition that damage the effectiveness of the system in the long term.

### **Inefficiencies of Competition Observed in Nash's Equilibrium**

Let's say that you and I own each a lemonade stand. We are in front of each other, we are the only lemonade stands in town and the quality of our lemonade, although they may differ in taste, does not separate us from each other in the number of clients that we get. We also sell our lemonade for \$1, and it costs us 50 cents to make it. We are both thinking whether we should drop our prices or not for the lemonade we sell. If one of us sells the lemonade a little cheaper, even if it is just one cent cheaper, he will get all the customers from the other lemonade stand. If we both drop the prices, we will cut onto our profit margins until we both sell at 50 cents, the price it costs us to make it just to breakeven. Or we could just both keep our prices as they are from the start. In order to comply with regulatory US laws, we cannot talk about our strategies, and we cannot sell at a loss.

It would make sense, in a similar way to the Prisoner's Dilemma situation, that both of us dropped the prices of the lemonade to take the other person's clients. But unlike in the Prisoner's Dilemma, this is not a one-time decision game. I can change my strategy according to what you do, and vice versa. In fact, if I drop the price to \$0.99, you will drop it to \$0.98, then I will drop it to \$0.97, and so on until reaching the 50-cent mark. But that would leave us with no earnings at the end of the day. That makes the most viable option to just stick to our current prices, and none of us should drop the prices unless the other one does. Keeping our prices at \$1 like this would not be

considered collusion, because we would not need to communicate this to each other to make sure we do not cut into our margins, we just need to hold our prices high until one of us drops them. Even if we are able to reduce our costs, we should still keep the price at \$1 to have the largest profit margins possible, as long as we reduce the costs in the same amount. That makes that option, keeping the status quo, a Nash's equilibrium and an optimal payoff for the both of us.

	YOU		
		DROP PRICES	NOT DROP PRICES
ME	DROP PRICES	(No profit, No profit)	(Monopoly, Bankruptcy)
	NOT DROP PRICES	(Bankruptcy, Monopoly)	(\$0.50 profit/client, \$0.50 profit/client) E

Fig. 6: The Lemonade Stand(off)

Nevertheless, in this situation of silent cooperation instead of competition, there are a number of unforeseen consequences that affect the grand scheme of economics in capitalism, making this a situation of a short-term win for you and me, but a long-term loss for the economy as a whole. You and I are both making money in this situation, so financially it makes sense for us to maintain the status quo. However, this situation of standoff is the killjoy of innovation. Since our businesses work fine the way they are, neither you nor I have any incentives to innovate and provide our clients with better lemonade, different flavors, or other sorts of solutions to our client's problems. In this fictional economy where only we make lemonade, we have made the market stall, and the quality of lemonade has reached its peak. It is the opposite of what is supposed to be the main advantage of capitalism, which is the idea that self-interest drives competition, and

competition drives innovation. There can be situations, within capitalism, in which competition is against self-interest, and if enough of those situations come up in several critical sectors of an economy, then the capitalistic economies' capacity for growth and improvement over time can be seriously limited, and there can be some fundamental problems, such as climate change perhaps, that cannot be solved properly within the scope of capitalism.

This means that, as a society, we need to go back to the drawing board and reinvent the game of economics. At the very least, we need to find a way to alter how the game is played, in such a way that Nash's equilibriums are always desirable because not only do they represent stability, but also optimal efficiency. Capitalism has fundamental problems that have been proven to be a result of the proper use of capitalistic thought within the system, therefore we must look outside of it to make a game that is truly sustainable long term and that it solves all the problems encountered with capitalism.

### **Zero-Sum Games and Non-Zero-Sum Games in Economics**

If we are to rethink our entire economic system to overcome these challenges that are beyond our control in capitalism, it is important to establish a framework on the nature of the game of economics that we want to play. There are different kinds of situations, or games, depending on the possible outcomes for all the parties involved. On the one hand, we have the zero-sum games, which are games in which a player's win equals a player's loss, so the total amount of the payoffs of all possible actions ends up being zero.<sup>41</sup> These kinds of games provoke win-lose situations, because in a finite zero-

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<sup>41</sup> "Zero-Sum Game Definition in Finance, With Example," Investopedia, accessed March 19, 2023, <https://www.investopedia.com/terms/z/zero-sumgame.asp>.

sum game there will be a winner and a loser, unless there is room for a draw in it. Basketball, soccer, or chess are examples of zero-sum games since they end up with a winner and a loser most of the time, and even if draws can happen in soccer or chess, there is always some sort of tie breaking criteria to ensure that nothing ever truly ends in a draw. Zero-sum games, therefore, enhances pure competition among participants. On the other hand, there are non-zero-sum games, which are situations in which a participant's gain does not necessarily imply a loss of equal significance to another participant, which means that the winnings and losses of all players do not add up to zero.<sup>42</sup> These games can present win-win scenarios in which every participant can benefit from the decisions and actions made by themselves and others too.

In relation to economics again, what kind of game is the one we are playing? To find a potential ideal outcome, a strategy to win in economics, we must conclude which is the nature of the game that we are playing. Can we all win, or just some people while the rest lose? The immediate answer to this question may depend on the focus one has on economics as a field. There are two approaches of how to study economics. Microeconomics studies the interaction of supply and demand in individual markets, which means that they focus on the little details and their subjects of study are individual people or companies.<sup>43</sup> Macroeconomics, in contrast, focuses on the big picture, the functioning of the overall economy through the study of the big phenomena, also called aggregate variables, that happen when all markets interact with one another.<sup>44</sup>

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<sup>42</sup> "Non Zero Sum Game," Monash Business School, accessed March 19, 2023, <https://www.monash.edu/business/marketing/marketing-dictionary/n/non-zero-sum-game>.

<sup>43</sup> "Micro and Macro: The Economic Divide," IMF, accessed March 19, 2023, <https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Micro-and-Macro>.

<sup>44</sup> "Micro and Macro."

From a capitalistic perspective, looking at the economy through the lens of microeconomics, it would appear to us that self-interest drives the agents' daily interactions. Every person in the world is ultimately looking for what is best for themselves, their families, their friends, and their loved ones. We do not just go to any bank to take out a loan payment for college, or open a mortgage for a house, we go to the bank that gives us the best deal possible regardless of the necessity of a nation to have a diversification of banks that service people to avoid the fatal financial consequences that a crisis that made that dominant bank go bankrupt would have. We do not just want to buy whatever food is in front of us, we try to find the best deal for ourselves in terms of money and quality because no one likes to overpay for a steak that is not of superior quality. I do not want to just write empty words for this thesis, I want it to be meaningful so that, at the very least, I finish my Philosophy major and I am able to graduate. Self-interest of the people forces the providers, the companies, and some self-employed people, to compete in the market to secure the best deals for the clients and do business. That competition ideally drives innovation in various forms, from new products to cover needs of people that have not been fully met, to processes that lower the cost of manufacturing a certain product, which gives the companies the chance to lower prices. Over time, that innovation is what makes the economy become an engine for societies to progress and improve. Goods that did not exist at some point became revolutionary, then popular among the masses, and then obsolete when that product, its strengths and its deficiencies inspired others to make a new substitute product for it. This is the example for the first kind of cars ever manufactured, which are the inspiration for modern cars now, but in current times more suited for a museum collection than everyday use. In this

kind of scenario, there will be winners who are those that are able to find or to propose the best deals for clients and stay at the top of their game in innovation of their products so their business is never obsolete, and the losers are those who fail to do so. Therefore, this is a scenario that is primarily based on competition.

On the other hand, from a macroeconomics perspective, the big picture suggests that the state of a nation's economy largely depends on cooperation between their citizens to improve the aggregate variables such as GDP that translate into more resources that the country can use to improve the national standard of living. Everything that is financed on tax money, from the roads of a country or state to the healthcare system in countries like Spain, is nothing but every citizen pitching in, even if it is mandated, to cover a fraction of the costs and be able to afford what otherwise could not be paid for by single individuals. If we kept a competitive mindset in these games or situations, we would all instead try our best to be free-riders and not put our part in it to try and use it for free, and it would not be possible to have any of these commodities or services.

Considering the dynamics of both kinds of examples for each approach on economics, I believe that ultimately, the game of economics is meant to be a non-zero-sum game with the possibility of a win-win outcome. The idea behind my reasoning is that all the competition that happens in microeconomics between individual agents is at the end of the day cooperation when looking at the big picture. We need trade and monetary activity to keep businesses afloat and people's needs reasonably met. If we all stopped trading, no one would have access to resources other than their own, money would be meaningless without anyone to trade it with for resources, and everyone's standard of living would decrease substantially. Competition is necessary and must be



protected, but it has to be understood in the context of general cooperation to achieve progress.

### **Establishing Metrics to Measure Economic Success**

Another question worth asking about the reinvention of our understanding of economics that we are trying to establish has to do with metrics. Is money, and all the aggregate variables associated with it, a good method to measure the success or failure of a company or a system? Ever since money has been a pivotal part of our activities we have been assuming so, but in the light of current climate predictions for the future of the planet, it seems clear that there are things that can affect us and transcend the human construction of money. After all, what use is \$100 billion for if they can't buy any resources or products because we have exploited the Earth past the limit of exhaustion?

An example of a business model that is successful financially but very harmful to the environment is Amazon. As they have increased the number of deliveries, they have also increased dramatically the emissions that they are responsible for because of the elevated transportation trips for deliveries and occasional excessive packaging to secure the product. Between 2019 and 2021, their carbon dioxide pollution has increased by 40%.<sup>45</sup> Not only that, but the convenience of the business model from the perspective of the buyer has made shopping lists obsolete, which means that we do not buy all we need at once, instead we buy when we find that we need something more often and in smaller size, often impulsively. This translates to more deliveries per client and excessive emissions that could be cut if Amazon found a way to promote environmentally sound

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<sup>45</sup> Justine Calma, "Amazon's Climate Pollution Is Getting Way Worse," The Verge, August 1, 2022, <https://www.theverge.com/2022/8/1/23287351/amazon-climate-change-carbon-emissions-worse-2021>.

purchasing habits. However, this would work against them financially because the number of deliveries they make would be smaller, meaning less success for the company. This is why what Amazon claims to do is participating in eco-friendly projects such as planting trees or claiming to be net-zero carbon by 2040 even though it does not actually result in real-world impactful reductions in the present.<sup>46</sup> And while those trees grow and eventually do take the CO<sub>2</sub> out of the atmosphere, it still accumulates in it and creates problems in the present.

This is why financial metrics cannot be used to measure the success of a company. We tend to believe that the market rewards the companies that provide more value to the customers with more purchases, but this idea fails to account for all the harm done in the process of bringing that value to the market beyond numbers in a balance sheet. Burning through tons of gallons of gas is only problematic for Amazon if gas is expensive. If it is cheap, these big companies can afford to use it with no measure because it does not affect its finances, but in the meantime, it does affect our atmosphere and the climate change problem.

From an environmental perspective, sustainable development seems like a suitable ideal for metrics on how one can be successful in economics, rather than money itself. It was initially defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”<sup>47</sup> This makes the successful

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<sup>46</sup> Calma, “Amazon’s Climate Pollution Is Getting Way Worse”; “Amazon’s Environmental Impact Delivers Climate Change Concerns | TechTarget,” SearchAWS, accessed April 19, 2023, <https://www.techtarget.com/searchaws/feature/Amazons-environmental-impact-delivers-climate-change-concerns>.

<sup>47</sup> United Nations, “Sustainability,” United Nations (United Nations), accessed March 19, 2023, <https://www.un.org/en/academic-impact/sustainability>.

companies not necessarily the richest or most powerful, but the ones that are being run in a business model that is viable now and in the foreseeable future. Richards and Gladwin already mentioned that impact-based metrics in environmental aspects are essential for sustainability,<sup>48</sup> but the problem is that, to this day, many companies just see that in their operations as something to comply with and not something to strive for from a business perspective. Even with metrics that measure a company's impact, such as the concept of carbon footprint which measures the total amount of greenhouse gases generated by human activity,<sup>49</sup> or in this case applied to that of the company, we cannot expect them to be fully prioritized over short-term monetary goals that keep the company alive.

The concept of circular economy would make companies strive for environmental efficiency that leads to sustainability, by offering a model that highly increases the importance of natural resource management efficiency. The mechanics that make this production system feasible under sustainability terms will be explained in the next chapter, but for now it is enough to establish the baseline for what we are trying to achieve in our new concept of economics, which is a conclusion that it is not money but sustainability what should measure our economic success.

### **Defining Losing in Economics**

Lastly, we need to determine what it means to lose in our understanding of economics. What would be rather intuitive to say in a zero-sum game with win-lose outcomes, it would be relatively easy to determine who is the winner and who is the

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<sup>48</sup> Deanna J. Richards and Thomas N. Gladwin, "Sustainability Metrics for the Business Enterprise," *Environmental Quality Management* 8, no. 3 (Spring 1999): 20, <https://doi.org/10.1002/tqem.3310080303>.

<sup>49</sup> "What Is Your Carbon Footprint?," The Nature Conservancy, accessed March 20, 2023, <https://www.nature.org/en-us/get-involved/how-to-help/carbon-footprint-calculator/>.

loser. Karl Marx was one of those that viewed this idea of economics in his explanation of class struggle, and in his idea was that there were in history an arrangement of society into social rank that during his time had evolved into two clearly defined antagonist groups, the owners of the means of production and the exploited and alienated workers. “The modern bourgeois society that has sprouted from the ruins of feudal society has not done away with class antagonisms. It has but established new classes, new conditions of oppression, new forms of struggle instead of the old ones.”<sup>50</sup> However, if economics is a non-zero-sum game and that the outcomes that can and should come from it are win-win, then Marxist theory would be flawed and Marx’s proposal of proletariat ownership of the means of production would be economically pointless.<sup>51</sup>

History does have a point against Marx’s implied idea that economics is a zero-sum game and there are people who over the course of history truly lose. We talked earlier in the text that back in the day the crises were much more severe than they are in the present day. The same could be said about Marx’s time compared to the Middle Ages. It is by all means a problem that lower-class households in the 1850s had to spend between 50 and 75 percent of their incomes simply on nourishment<sup>52</sup> but it was worse in the Middle Ages when the Black Death took the lives of at least a fourth of the European population.<sup>53</sup> Marx sees losers and winners in history and, by extension of his argument,

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<sup>50</sup> Karl Marx and Friedrich Engels, *The Communist Manifesto*, 1st Signic Classic print (New York, NY: Signic Classic, 1998), 51.

<sup>51</sup> Despite the impossibility of applying Marx’s thought to non-zero-sum, win-win economic theories, Marx’s ideas related to the exploit of the working class are relevant from a political and social perspective. In fact, they arguably play a part in shaping circular economy. Avoiding the exploit of humans is as important as avoiding the exploit of nature. However, I believe other authors such as John Rawls have a more accurate model that suits better the idea of circular economy and economics in general.

<sup>52</sup> Helge Berger and Mark Spoerer, “Economic Crises and the European Revolutions of 1848,” *The Journal of Economic History* 61, no. 2 (2001): 296.

<sup>53</sup> Langer, “The Black Death,” 114.

in economics because the way he sees winning and losing is relative. On a soccer or basketball game one team wins only if they score more goals than the other team. My team could score 30 points in a basketball game and win if I could hold the rival team to 29 points or less, and it could also score 150 points and lose if the other team scores 151 or over. Marx sees something similar in society with people with very large incomes and people with significantly lower incomes, who lose in comparison to them, but he fails to see or to properly give value to the fact that the situation for people generally improves over time in history. Economics has too many variables to truly expect equality among everyone, so to have it as a goal is not realistic.

I propose that, in a win-win game such as that of economics, we should get rid of that relative perception of what losing is in economics. Losing should be defined in absolute terms instead. Things like having food insecurity, being homeless, or having one's own fundamental rights negated should absolutely be considered as losing scenarios for those who suffer them. And for those who do not suffer these situations in first person, it also affects them negatively because those people in extreme situations cannot contribute properly to economic progress with their labor or tax money since they have other priorities at the time and they need to be helped by society as a whole in a lost fund situation, not expecting that money to be made back necessarily and hoping they one day can get out of that situation and stop costing the society money that they desperately need to survive in the form of, for example, food shelters.

In the spirit of avoiding those situations of absolute loss, I believe that American political philosopher John Rawls' political theory based on a specific conception of utilitarianism can be applied to this case. Rawls argues under the concept of the

difference principle that social and economic inequalities are tolerable, and perhaps even desirable, if it is for the greatest benefit of the least-advantaged members of society.<sup>54</sup> Higher wages for certain jobs that are in high or rising demand can cover training and education, which acts as an incentive for those jobs to be filled. Higher wages can also, in our current tax system, contribute with larger sums of money to the public administration of a nation, which can be used to fund services that people, and especially people in the lower ranks of society, need the most, such as public transportation or subsidized free of charge healthcare. Inequalities are not a problem by themselves, they can in fact be useful as long as they serve everyone's advantage and especially the ones who sit at the bottom of society. The ultimate goal, in the end, is not to reach equality but to raise the floor of society.

Nevertheless, Marx's point of large differences between social classes being problematic is valid. Some of the absolute loss scenarios that were mentioned earlier are much more likely to happen when the differences between social rank are so large that oppression from those in the high ranks over those in the low ranks of society can pass off unpunished. For example, patricians in Ancient Rome could own slaves and do as they wished with them with no implications regardless of how cruel the treatment they'd give their slaves was because they were just considered objects, property. Regarding this point, Rawls mentions that for a society to have an appropriate, liberal political conception of justice there must be certain specific features regardless of the differences in the reasonable interpretations of freedom, equality, and fairness.

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<sup>54</sup> Leif Wenar, "John Rawls," in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta, Summer 2021 (Metaphysics Research Lab, Stanford University, 2021), sec. 4.3, <https://plato.stanford.edu/archives/sum2021/entries/rawls/>.

1. A liberal political conception of justice will ascribe to all citizens familiar individual rights and liberties, such as rights of free expression, liberty of conscience, and free choice of occupation;
2. A political conception will give special priority to these rights and liberties, especially over demands to further the general good (e.g., to increase national wealth) or perfectionist values (e.g., to promote a particular view of human flourishing);
3. A political conception will assure for all citizens sufficient all-purpose means to make effective use of their freedoms.<sup>55</sup>

These three features, unified with the fair equality of opportunity that argues that all social and economic inequalities are accepted as long as the privileged offices and positions are available to members of all social classes<sup>56</sup> guarantee a number of important things in a society and in an economy. On the one hand, it protects people's basic rights, such as basic healthcare for all citizens, or public financed elections in which everyone can exercise their right to vote. On the other hand, it guarantees equality to a reasonable extent in opportunities for all citizens regardless of their social class and it envisions a society in which people's belonging to a certain social class is not stagnant. There is a

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<sup>55</sup> Wenar, "John Rawls," sec. 3.4.

<sup>56</sup> Wenar, "John Rawls," sec. 4.3.

somewhat feasible path for people to go from the lowest social class to the highest one, and everything in between.

### **The Problem of Automation and Possible Opportunity Window to Solve It**

Regarding that last point that John Rawls makes, our current society seems to be headed to a certain social problem due to the progress of automation. It is not only taking jobs that were once done by people to earn an income, which is not a problem in itself because it also makes space for new jobs that did not exist before. In fact, it is expected that by 2025, technology will create 12 million more jobs than it will destroy, which highlights how in principle this phenomenon should be a net positive for society.<sup>57</sup> The problem arises when one looks at the kind of jobs that are already disappearing or are at risk of disappearing because robots take over and do a better job at them than humans do.

Robots are cheaper than human workers, and they are not as problematic to deal with in many instances, such as pay since they do not require any, or the fact that there are no such thing as human working conditions that must be met for them because they are not humans in the first place. On top of that, they cannot disobey orders or commands because they do not have free will, and they are more efficient at performing repetitive, high-volume tasks.<sup>58</sup> Entire sectors and areas of business such as accounting or commercial driving could see large portions if not their entire human fleck replaced by software. These jobs at risk generally belong to the middle class. The people who are

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<sup>57</sup> Ashley Nunes, “Automation Doesn’t Just Create or Destroy Jobs — It Transforms Them,” *Harvard Business Review*, November 2, 2021, <https://hbr.org/2021/11/automation-doesnt-just-create-or-destroy-jobs-it-transforms-them>.

<sup>58</sup> Jonathan Tilley, “Automation, Robotics, and the Factory of the Future,” *McKinsey & Company*, 2017, 69.



being displaced of their jobs can either educate themselves to get jobs that require specialized skills, such as code developer, or get jobs that do not require specialized skills they do not have, but also pay significantly less, such as retail work, nannying, or perhaps teaching, which is a skilled job that requires skills that are not easily replaced by machine learning. The result of this is a rupture in society between high-skilled, highly paid workers, and low-skilled workers who make much less money in their jobs, and it kills the possibility of moving from one end to the other, contrary to what Rawls suggests a society should look like. While learning soft skills that are not part of the robots' excellent curriculum such as presentation skills, creativity, empathy, or situational awareness can help in coping the labor infiltration that robots are producing,<sup>59</sup> I do not believe that this measurement by itself will be enough to avoid this issue.

The context of transitioning from a linear economy to a circular economy may be a good moment to tackle these issues. Even though by itself circular economy does not provide a specific solution to the problems of automation, the situation of change can be used to reinstitute jobs that are now part of the low-appreciation, low-payment segment of the world of work into a more valued, better paid kind of positions. There are certain tasks that, even if a robot can perform them with the same professional standards and in a more efficient way than a human could, that is not enough to replace a human worker because we value human interaction highly. For example, in retirement homes, it could be possible in the future that a robot nurse can check vitals and take care of elderly people as well as a human nurse can, but if we have to put our elderly loved ones in a

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<sup>59</sup> David Brooks, "Opinion | In the Age of A.I., Major in Being Human," *The New York Times*, February 3, 2023, sec. Opinion, <https://www.nytimes.com/2023/02/02/opinion/ai-human-education.html>.

retirement home, we would rather send them somewhere where they will have at least some human interaction because we value that connection and we cannot get that from a robot. Even in a context in which human and robot nurses coexist, it would be reasonable to believe that human nurses would be paid at a premium that those who would be able to pay for it would certainly do it.

### **Current Summarized Situation and Game Theory Grid**

We could summarize the situation of our current economy in regards with environmental and social aspects in the following way to build a situation that we can simplify in the shape of a game theory grid. Even though our capitalist economy and our linear production system have supported remarkable progress in the past, it has reached a point in which the threat of an environmental, financial, and social crisis of catastrophic dimensions in the foreseeable future is very real. It has also been proven that the issues that have led us to this position are not errors made by not applying properly the tools and concepts of capitalism, but because of fundamental flaws of the system that cannot be fixed without changing the system altogether. I have also shown an alternative to capitalism, circular economy, that could in principle be a way to avoid a crisis of devastating magnitude. Details of how the circular economy operates and how it relates to the philosophical thought mentioned here will be discussed in the next chapter to show that it can be implemented in a practical global setting.

We could find ourselves in a situation in which we can picture ourselves as business owners, as opposed to the rest of our competition in any industry of your choosing. To simplify the chart, instead of writing down every single company that

constitutes our competition, we just list the competition as one entity, and the actions that it takes are the actions that a reasonable majority of the competition will be taking. Our possible actions, and those of our competition, are to stay on a linear economy production process like the one we currently use, or to adopt circular economy. This thought experiment shows that there is no reason for either me or the competition to maintain a linear economy production process because it leads to either a fatal crisis or bankruptcy for our own business. The only action that we would not regret taking is adopting circular economy, because either we cannot avoid the fatal crisis because the competition does not follow suit and fails to properly cooperate when needed, or if us and the competition follow suit, then our business survives and so does the ones that constitute the competition. Adopting a global circular economy will require of some very drastic changes that will most likely trigger a crisis by itself and will be further explained, but the fact that, if done right, we would not be facing dramatic consequences of the scale of the crisis that we are walking towards as a society should we continue to walk the path we are walking as of today makes than consequence worth it.

		THE COMPETITION	
		STAY ON LINEAR ECONOMY	ADOPT CIRCULAR ECONOMY
US	STAY ON LINEAR ECONOMY	(Economic status quo short-term followed by a fatal crisis, Economic status quo short-term followed by a fatal crisis)	(Short-term economic gain but long-term bankruptcy, short-term losses followed by a milder crisis and then survival of the businesses)
	ADOPT CIRCULAR ECONOMY	(Short-term economic loss followed by a devastating crisis, short-term economic gain followed by a fatal crisis)	(Short-term economic status quo followed by a milder crisis and survival of the business, Short-term economic status quo followed by a milder crisis and survival of the business) E

Fig. 7: A summary of why you should adopt circular economy in your business.

As it has been explained in the introduction, and suggested in this game theory grid, there is no possibility of escaping a crisis. Whether we make that crisis our own and build a better, more sustainable model from it, or we continue with the current status quo and face a much larger crisis in which proactivity will not be a possibility for society at large is for us to decide. Even though the scenario highlighted by Nash's equilibrium is

still not ideal because there is still crisis, the options at the end of the day force us to choose between the lesser of two evils.

### **Final Chapter Conclusions**

To conclude, over the course of this chapter I have come up with certain central ideas that will work as red lines to shape how our new economic model will look like. They are summarized and listed here, so that they can be revisited at any point in the thesis:

1. As much as our current and former civilizations might have progressed and thrived in the past, not once have we been able to overcome our dependence on nature.
2. Capitalism as a system has fundamental flaws, its shortcomings go beyond people's occasionally irrational or wrongful actions, and they pose a threat to the future of our current civilization.
3. Competition is vital in microeconomics and must be protected, but it has to be properly framed in the macroeconomic picture as ultimately a form of cooperation.
4. Economics is a non-zero-sum game that can and should present win-win outcomes.
5. Sustainability metrics, not financial metrics, should be used to measure economic success.
6. Losing in economics should be expressed in absolute terms, not relative.

7. Even if social and economic inequality exists in society, it is tolerable as long as the floor and there is a plausible path for people to climb from the lower social classes to the higher ones.
8. The context of transitioning from linear to circular economy could present opportunities to fix other problems in society that circular economy is not meant to solve in principle, such as the division of the society as an effect of automation.

# Chapter II: The Mechanisms and Flaws of Linear Economy

## Models

Our current linear economy model will be the starting reference needed for the explanation of the concept of circular economy, and how to transition from one to the other. Even though some of what goes on in this chapter has already been introduced in chapter I, this chapter will dive more deeply into the concept of linear economy itself and how each of the parts that compose the process works, including its impact in the environment through its contribution as a key factor in both climate change and scarcity of resources. This includes a discussion about planned obsolescence, a generalized business practice in certain sectors that shortens the life of the products purposefully to create the need for the customers to buy new products as replacements for the old ones. After that, the explicit reasons why linear economy models fail to fulfill the Lockean proviso, Maslow's Hierarchy of Needs, game theory, and John Rawls' politics will be addressed.

By the end of this chapter, there should be no debate about the inability for linear economy models to live up to our own standards of economics. It should be proven that not only it fails to fulfill the ideas of the thinkers mentioned above, but it also fails to operate under the red lines that we established in chapter I. Only then there will be a proper understanding of the current state of linear economics that will allow us to address the alternative solution of circular economy.

## **The Linear Economy Production Model**

The linear economy production model takes its name because the materials are introduced constantly and once the product that is built from them is unusable, they become waste that becomes very problematic to manage. It ends up being stored in waste management facilities for the most part, and only a very small percentage of the materials is recycled and reintroduced into the production line. Even in recycling scenarios, the materials that are reintroduced back are deteriorated in comparison with the newer materials, which means that they cannot be true substitutes for the new materials. Thus, new materials and products need to constantly be introduced or else the production line collapses.

Regardless of the industry that we are talking about, all the production lines share the same stages of production, although the differences between heavier and lighter industries can significantly affect how each of these stages looks. In each of these stages, pollution of some kind is happening as a consequence of these human activities, and some form of misuse or mismanagement of resources is happening that diminishes the optimization of the process. In the case of linear economy production models, this is something that we just have to accept as part of the process itself, and we can only try to minimize the extents of waste and pollution.

### **Extraction**

The first step in this model is the extraction of materials from the Earth. This can take different forms depending on the material that one is trying to extract, but just to pick a very common one, we will follow the extraction of aluminum which is widely used



in the transportation industry to build all kinds of vehicles. Aluminum does not just grow in the world; its ore, bauxite, needs to be mined first. The activities that are part of extraction range from having to clear all the timber, vegetation, and the top layer of the soil of the area, to in some cases making the galleries to access the bauxite deposits if the option of open cast mining is not possible.<sup>60</sup> Once the bauxite is extracted and broken down into manageable pieces, it is transported in trucks to the facility in which the next step takes place, to process it and separate the aluminum from the ore. Almost all of these processes involve the use of heavy machinery and suppose a very significant negative impact for the environment, both in the emission and pollutants that these heavy machines produce and in the impact to the landscape, especially relevant in the most common open cast mining practices for this specific material.

The large majority of the environmental impacts regarding aluminum come from primary aluminum that has been or is being newly produced, with especially concerning levels in its impact to climate change, toxicity, and human health PM impacts.<sup>61</sup> Collectively, all activities regarding the extraction and processing of materials, fuels, and food make up half of the total greenhouse gas emissions, and over 90% of biodiversity loss and water stress, of which agriculture is mostly responsible.<sup>62</sup> This initial step is the most impactful in the environment and expenditure of resources, as well as the one in which the most pollution happens. Circular economy models are expected to have a large

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<sup>60</sup> “Mining and Refining – Process,” accessed April 9, 2023, <https://bauxite.world-aluminium.org/mining/process/>.

<sup>61</sup> Bruno Oberle et al., “Global Resources Outlook 2019,” *International Resource Panel*, December 3, 2018, 79, <https://www.resourcepanel.org/reports/global-resources-outlook>.

<sup>62</sup> Bruno Oberle et al., “Global Resources Outlook 2019,” 27.

environmental impact largely because it should allow us to skip this step in many instances because we will not need to extract as many materials as we currently do.

## **Refining**

After extracting the materials, the next step is to refine the materials to turn them into products that factories can use efficiently. In the case of aluminum, two major steps are required to transition from bauxite to aluminum. The first step, known as the Bayer process, is used to obtain aluminum oxide, or alumina. Firstly, the bauxite is crushed, washed, and dried before being dissolved with a heated sodium hydroxide solution. After filtering the mix to remove impurities the solution that now contains oxides of aluminum is transferred to a precipitator where the solution cools and small aluminum hydroxide particles are added to stimulate the growth of aluminum hydroxide crystals. The crystals settle at the bottom of the precipitator and are removed, while the rest of the aluminum hydroxide is washed off and heated to remove residue and excess water, which ends the process with a white odorless powder, which is alumina.<sup>63</sup>

The second step is called the Hall-Heroult process, and it is based on another chemical reaction that allows to separate the oxygen from the aluminum. By adding cryolite to the alumina, not only did it lower its melting point, but it also allowed for the solution to be more conductive, allowing electrolysis to happen at a much higher voltage, enabling a simple process to achieve pure aluminum.<sup>64</sup> During the electrolysis, the solution is kept at a very hot temperature, which combined with the lowered melting

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<sup>63</sup> “Aluminum Production & Manufacturing Process Explained,” HARBOR Aluminum, accessed April 9, 2023, <https://www.harboraluminum.com/en/aluminum-process>.

<sup>64</sup> “The Abandoned Cryolite Mining Town of Ivittuut,” accessed April 9, 2023, <https://www.amusingplanet.com/2020/01/the-abandoned-cryolite-mining-town-of.html>.

point of the solution, allows for the oxygen and aluminum molecules to separate.<sup>65</sup> After this process, the aluminum is ready to enter the next step of linear production.

The refining step of each product may be significantly different depending on the characteristics and future uses of said product. In the example of aluminum, or many of the metals that are extracted from their ore, it very often involves processes that provoke controlled chemical reactions, for which facilities usually need of furnaces or similar devices that reach very high temperatures, enough to melt the metal and other materials that constitute the ore. These items need either very large voltage, or combustion of materials, for which they need large amounts of energy. To achieve all this energy, more often than not heavy industries will rely on fossil fuels such as petrol or coal to guarantee sufficient energy to function, which means that this step is also quite harmful for the environment. A life-cycle impact analysis on the production of aluminum made by Farjana, Huda, and Mahmud revealed that it is the refining step, and more specifically the smelting of the alumina, the step that is the most harmful of all of the production process of aluminum<sup>66</sup> because of the enormous amount of electricity that smelting requires and the electricity generation resources available to operate at such high voltages.<sup>67</sup> This may be the same for many other metal production processes as well because of the technological difficulties of extracting metals from their ores efficiently at an industrial level.

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<sup>65</sup> “Aluminum Production & Manufacturing Process Explained.”

<sup>66</sup> Shahjadi Hisan Farjana, Nazmul Huda, and M. A. Parvez Mahmud, “Impacts of Aluminum Production: A Cradle to Gate Investigation Using Life-Cycle Assessment,” *Science of The Total Environment* 663 (May 1, 2019): 962–63, <https://doi.org/10.1016/j.scitotenv.2019.01.400>.

<sup>67</sup> Farjana, Huda, and Mahmud, “Impacts of Aluminum Production,” 970.

Another issue with this step is the use of scarce materials to make these sorts of processes more energetically efficient. In the specific case of aluminum, the discovery of cryolite as a way to increase the conductivity of alumina allowing for the process of electrolysis to happen with relatively reasonable, albeit very high, amounts of electricity meant that the demand for this material skyrocketed during the 20<sup>th</sup> century. Although cryolite has been found in other parts of the planet, there was only one place where it was commercially extracted, the town of Ivittuut, in Greenland's southwest coast. At first cryolite was mined in low quantities because of its low amount of aluminum, significantly inferior to bauxite. However, when chemists Charles Martin Hall and Paul Hérolt independently discovered the properties of cryolite when added to the bauxite solution, aluminum transformed in the economy from an expensive commodity to a commonly found material with specially interesting applications in aviation.<sup>68</sup> During World War II, this mining town became so important that the US Navy and Coast Guard opened bases nearby and no photographs of the area or contact with family were allowed because of fear that the Germans would intercept that information.<sup>69</sup> Following the war, the mine continued to expand, supplying 3.7 million tons of ore grading 58% cryolite until 1962, when there was virtually no more cryolite to extract.<sup>70</sup> By 1987 the mine was abandoned, and from then on natural cryolite has been considered essentially extinct because of its scarcity and difficulty of extraction, and because using synthetically

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<sup>68</sup> "The Abandoned Cryolite Mining Town of Ivittuut."

<sup>69</sup> "The Abandoned Cryolite Mining Town of Ivittuut."

<sup>70</sup> Steve Voynick, "CRYOLITE: 'The Ice That Never Melts' | Rock & Gem Magazine," September 24, 2019, <https://www.rockngem.com/cryolite-the-ice-that-never-melts/>.

produced sodium aluminum fluoride became a cost-effective alternative given that we had used all of the natural resources.<sup>71</sup>

While so far humanity has not been at a truly loss of materials without the discovery of a substitute material of similar, if not better, characteristics, we have been approaching to a point in which a future in which something like that happens by overuse of materials that are very scarce in the planet. A very relevant example is the smartphone industry that has been drastically growing in the last decade. As of 2021, 60% of the world population own a smartphone, and each one of them can carry around 80% of the elements on the periodic table.<sup>72</sup> Many of these materials are not easy to find, and it could well be the case that finding substitutes for these materials becomes problematic at best. According to a 2015 Yale study, there are a number of widely used metals, such as copper, that do not have good available substitutes for their major uses.<sup>73</sup> In fact, none of the 62 metals in the periodic table seem to have any substitutes that provide exemplary performance across all the major uses,<sup>74</sup> which suggests that even if the assumptions of the study are not entirely precise, we may find ourselves in situations where critical materials have run out and, without proper substitutes, we cannot make new smartphones with the same quality and level of performance as the old ones, let alone enhanced features.

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<sup>71</sup> “The Abandoned Cryolite Mining Town of Ivittuut”; Julian Turner, “Mined into Extinction: Is the World Running out of Critical Minerals?,” *Mining Technology* (blog), April 9, 2017, <https://www.mining-technology.com/features/featuremined-into-extinction-is-the-world-running-out-of-critical-minerals-5776166/>.

<sup>72</sup> “This Graphic Shows What Your Smartphone Is Made Of,” World Economic Forum, August 27, 2021, <https://www.weforum.org/agenda/2021/08/this-visualization-breaks-down-the-metals-in-a-smartphone/>.

<sup>73</sup> T. E. Graedel et al., “On the Materials Basis of Modern Society,” *Proceedings of the National Academy of Sciences* 112, no. 20 (May 19, 2015): 6295–6300, <https://doi.org/10.1073/pnas.1312752110>.

<sup>74</sup> Graedel et al., “On the Materials Basis of Modern Society.”

This would create a very interesting market situation, similar to the one mentioned in chapter I about the scarcity of silver in the Roman Empire that eventually led to the fall of Ancient Rome. Just as people tried to preserve the old coins that contained more silver, people would preserve their smartphones as much as they possibly could, slowing down the market and refusing to pay a similar amount for a lower quality product. Smartphone companies would find themselves having to drop prices significantly and progressively because of this issue as the scarce materials run out, eventually leading to a significant backward effect in the progress of society by way of worse products being introduced into the market while the old, better ones slowly disappear as they deteriorate, sinking the value of the item and potentially harming the companies' financial sustainability in the long run. This risk would be added to the environmental risk of continuing to constantly extract primary materials from the Earth, including its aftermaths in human health. These include, in the case of air pollution, a higher risk of suffering respiratory infections, heart disease, and lung cancer which translate into premature mortality.<sup>75</sup>

### **Manufacture and Assembly Steps**

In the following two steps of the linear economy model of production, the environmental impact is still important, but less significant than in the steps of extraction and refining because the machinery needed to build the parts that make the products and assemble the pieces that constitute the product together are not as heavy, therefore emitting less pollutants than their counterparts. These two steps are also hard to

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<sup>75</sup> "Health Consequences of Air Pollution on Populations," accessed April 19, 2023, <https://www.who.int/news/item/15-11-2019-what-are-health-consequences-of-air-pollution-on-populations>.

distinguish when observing a production line, given that very often they will take place in the same facility and there is no break between making, for example, the car parts and assembling the car together. As the pieces are being made, they are assembled and a car ready to be used is the outcome after having had the initial inputs of resources and energy. However, in these parts there are still issues that affect the way in which these products perform in the rest of the production model, which could be considered inefficiencies of the production line.

These are related to how we think of success and growth. If it were for a matter of just wanting to limit our consumption of resources and exhaustion of fumes into the atmosphere, we would just live a humbler life, purposefully reducing our consumption of all kinds of products, and live a slightly more inconvenient life for the sake of sustainability. These ideas are meant to purposefully shrink our economy and standard of living, and while they can work on paper, they do not adjust to the ambitions and expectations of humanity. An example would be the use of cars, one of the industries that uses the most aluminum in the world. One of the reasons why aluminum was initially introduced in this industry was because it is much lighter than steel, which improves some of the features of the car, such as fuel mileage, power output of the engine that allows for smaller engines to be used in larger cars, or better handling which makes the car safer.<sup>76</sup> However, even though these improved car features can have a positive impact on the environment by, for example, consuming less fossil fuels or having longer lasting

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<sup>76</sup> “Pros & Cons of Lightweighting Automobiles,” accessed April 10, 2023, <https://countervailproducts.com/insights/blog/pros-cons-of-lightweighting-automobiles>; Alessio Gullino, Paolo Matteis, and Fabio D’Aiuto, “Review of Aluminum-To-Steel Welding Technologies for Car-Body Applications,” *Metals* 9, no. 3 (March 2019): 315, <https://doi.org/10.3390/met9030315>.

batteries in the case of electric vehicles, these inputs are designed to adjust to customer preferences more than they are motivated by environmental demands, which means that they can be very volatile and can also not be even beneficial for the environment in some cases. According to Deloitte, product quality and vehicle features matter significantly more to customers when deciding their choice of brand for their next vehicle than the brands' efforts related to environmentalism.<sup>77</sup> This explains why, from a consumer point of view, we might say that we care about environment and having a good fuel mileage that saves us gas money, but still many people in the US drive very large pickup trucks when they probably could use a car that is half the size of that.

The first model of the Ford F-150, built in 1975, was designed as a workhorse with a ratio of 36% cab and 64% bed.<sup>78</sup> It was marketed as a truck whose comfort features included comfort features that made it work like a truck and drive like a car.<sup>79</sup> Over time, the trucks became large luxury family cars and stopped being used for their initial purpose, which led to customer requirements changing towards more leg room, more comfort features, and increasing technology being added to the model as it kept being updated. The newest model, the 2021 SuperCrew cab, is a record 111 inches long with 63% cab room and 37% bed room with adaptive cruise control, hybrid drive trains, driver assistance and touchscreens.<sup>80</sup> Ford also increased in height and weight, which made them more dangerous to pedestrians and other drivers on the road. The average US

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<sup>77</sup> "2023 Global Automotive Consumer Study," Deloitte United States, accessed April 10, 2023, <https://www2.deloitte.com/us/en/pages/consumer-business/articles/global-automotive-consumer-study.html>.

<sup>78</sup> Will Chase, Jared Whalen, and Joann Muller, "Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous," accessed April 10, 2023, <https://www.axios.com/ford-pickup-trucks-history>.

<sup>79</sup> Chase, Whalen, and Muller, "Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous."

<sup>80</sup> Chase, Whalen, and Muller, "Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous."



8 year old kid would not be in the line of view of the drivers of these trucks,<sup>81</sup> and this added to the 32% weight increase of these models between 1990 and 2021 has made these trucks deadlier in the event of an accident.<sup>82</sup> Car drivers are 2.5 more likely to die in the event of collision with a pickup truck in comparison to another car, and they have twice the fatality rate on pedestrian strikes.<sup>83</sup> Despite this data, the 2022 Ford F-150 model earned “good” or “superior” ratings in crash tests.<sup>84</sup>

Even though these changes imply danger to other people and have a big impact on the environment because more materials are needed to assemble these trucks, in reality these truck drivers do not actually use their trucks much differently than car drivers use their cars. 87% of Ford F-150 users frequently use their trucks for shopping or errands, while 28% of them use the trucks frequently for personal hauling and only 7% of them use their truck frequently for towing.<sup>85</sup> Most of these drivers do not actually need the truck for what the features of a truck are supposed to be, so why do they keep buying them? Because the newly associated features to them have become a commodity and a sign of high societal status. They demand a truck with these features because it makes them feel better about the quality of the truck, and they demand a truck over a car because of the specific status and brand image of these car designs, even if a car could do the job just as successfully. They do not need the truck. They just want a truck over a car for reasons that are neither utilitarian nor virtuous, but nonetheless they are valid on the market.

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<sup>81</sup> Chase, Whalen, and Muller, “Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous.”

<sup>82</sup> Chase, Whalen, and Muller, “Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous.”

<sup>83</sup> Chase, Whalen, and Muller, “Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous.”

<sup>84</sup> Chase, Whalen, and Muller, “Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous.”

<sup>85</sup> Chase, Whalen, and Muller, “Pickup Trucks Have Gotten Bigger, Higher-Tech — and More Dangerous.”

## **Planned Obsolescence**

Any industry in which customer trends change faster than the products will have the risks of making products that last so long that the customers do not need to buy their newer products for a long time after purchasing the older ones the first time. The new customers do not usually come right away because even if the difference in the price to quality ratio of the product is significantly better on a different car, that does not justify the customer changing the car he just bought. This means that sales might stall because a company made a product that was too good for the time it was made, and it covered greatly certain customer requirements that have since changed over time. At the end of the day, for the company side of any business, a product is only as good as the sales it brings to them. Therefore, in order to be able to adapt to trend changes, businesses may be inclined to make products that adapt well to the current customer requirements but are not as long lasting. When the customer requirements have changed significantly enough, these people will need a new car as it will be approaching the end of its useful life, and the businesses will have designed a new model updated to the new needs, meaning that they will get more sales in the long run.

However, such a cycle is very harmful for the environment and for the handling of scarce resources because it forces businesses to extract and refine even more materials. The pieces that are designed to be manufactured and assembled into a product are not meant to maximize their useful life. Instead, they are designed to last just enough to satisfy their customers, but not so long that it affects their sales.

This practice is called planned obsolescence, and it is used in many products to prematurely age the components of it. It can happen in two different ways. The first one involves altering the product's features so that after a honeymoon period usually covered by a warranty, the entire product no longer functions or its performance decreases significantly.<sup>86</sup> This can be done from the desire phase in two ways. One option is to alter the hardware or purposefully add features that make the product physically unusable. An example would be the industry of home printers, with brands like Epson designing their printers to stop functioning after a specific number of pages are printed, leaving the customer with an error message. Reports from years ago show that Epson printers would display a dreaded message saying that parts inside the printer have reached the end of their service life.<sup>87</sup> Epson argues that printers are designed to stop operating when some parts need to be changed, not because they necessarily malfunction but because they do not want to assume the risk of the printers committing property damage, but even if this may sound reasonable because they do not want to be held liable for that, it is basically an admission of a known expiration date of the hardware that is programmed.<sup>88</sup>

The other option to make products age prematurely is to program and remotely activate the obsolescence, usually through regular updates and continuous software improvements that are only compatible or ideal for newer devices, making the old ones functionally over-programmed and too slow and prone to crashing to be used.<sup>89</sup> In 2018,

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<sup>86</sup> Lieselot Bisschop, Yogi Hendlin, and Jelle Jaspers, "Designed to Break: Planned Obsolescence as Corporate Environmental Crime," *Crime, Law and Social Change* 78, no. 3 (October 1, 2022): 271–93, <https://doi.org/10.1007/s10611-022-10023-4>.

<sup>87</sup> Jess Weatherbed, "Bricked Epson Printers Make a Strong Case for User Repairability," *The Verge*, August 11, 2022, <https://www.theverge.com/2022/8/11/23301272/epson-ink-pad-right-to-repair>.

<sup>88</sup> Weatherbed, "Bricked Epson Printers Make a Strong Case for User Repairability."

<sup>89</sup> Bisschop, Hendlin, and Jaspers, "Designed to Break."

both Apple and Samsung were fined by the Italian Competition Authority for “unfair commercial practices concerning software updates which seriously impaired the functioning of certain models of mobile phones.”<sup>90</sup> Perhaps you have even experienced this personally when your phone slows down suddenly after some time when it worked flawlessly.

Another way in which planned obsolescence can happen is by making repairs hard and not cost-effective for consumers so that they give up on their old product and buy new one instead. Epson, Apple, and Samsung all partook in these activities to put obstacles to customers that wanted to repair their property over buying new one. Epson technically did offer solutions to those who wanted to repair their printers, but they were clearly inconvenient and designed for the customer to be forced to choose to work and pay Epson for the repair. These undesirable solutions included sending the printer to Epson to replace the ink pads that allegedly were problematic or having a certified technician do it.<sup>91</sup> Before the issue gained relevance, Epson manipulated their customers by blatantly discouraging repairs altogether.<sup>92</sup> Regarding Samsung and Apple, they both had misleading omissions about the updates’ impact on the devices’ batteries, preventing customers from making a conscious decision regarding their property.<sup>93</sup> Additionally, Samsung also deliberately did not provide customer assistance for the products, which

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<sup>90</sup> Alberto De Franceschi, “Planned Obsolescence Challenging the Effectiveness of Consumer Law and the Achievement of a Sustainable Economy: The Apple and Samsung Cases,” *Journal of European Consumer and Market Law* 7, no. 6 (December 1, 2018), <https://kluwerlawonline.com/api/Product/CitationPDFURL?file=Journals\EuCML\EuCML2018044.pdf>.

<sup>91</sup> Weatherbed, “Bricked Epson Printers Make a Strong Case for User Repairability.”

<sup>92</sup> Weatherbed, “Bricked Epson Printers Make a Strong Case for User Repairability.”

<sup>93</sup> Franceschi, “Planned Obsolescence Challenging the Effectiveness of Consumer Law and the Achievement of a Sustainable Economy.”

were already past the warranty period, to accelerate the products' substitution.<sup>94</sup> These are all practices that go against consumer law and have the potential to seriously damage the market by making consumers doubt of the integrity of the entire sector when big brands like the ones aforementioned commit such crimes against the customer's right of making conscious choices. Apple and Samsung were penalized by paying a fine and by displaying a public amending declaration in the Italian version of their homepages with a link to ICA's decision.<sup>95</sup>

While these are clearly examples of malpractice being made at the design level intentionally, current legislation regarding this crime is very lenient. In fact, it is barely treated as a fine at all, despite very obvious cases of lying and manipulating the customer to their own benefit, while it made the customer worse off. Apple and Samsung's fines were only €10 million and €5 million respectively,<sup>96</sup> an equivalent of roughly \$10.9 million and \$5.4 million in today's current rate exchange. That amount is minuscule for companies of their size. Apple's total net worth as of the end of 2022 was \$56.727 billion,<sup>97</sup> while Samsung's net worth is even larger at \$274.755 billion,<sup>98</sup> which makes fines in the magnitude of millions of dollars insignificant. That is to the median household income in the US of \$69,021<sup>99</sup> the equivalent of paying a fine of \$13.26 in the

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<sup>94</sup> Franceschi, "Planned Obsolescence Challenging the Effectiveness of Consumer Law and the Achievement of a Sustainable Economy."

<sup>95</sup> Franceschi, "Planned Obsolescence Challenging the Effectiveness of Consumer Law and the Achievement of a Sustainable Economy."

<sup>96</sup> Franceschi, "Planned Obsolescence Challenging the Effectiveness of Consumer Law and the Achievement of a Sustainable Economy."

<sup>97</sup> "Investor Relations - Apple," accessed April 10, 2023, <https://investor.apple.com/investor-relations/default.aspx>.

<sup>98</sup> "Financial Statements | Financial Information | Investor Relations | Samsung Global," Samsung global, accessed April 10, 2023, <https://www.samsung.com/global/ir/financial-information/audited-financial-statements/>.

<sup>99</sup> "U.S. Census Bureau QuickFacts: United States," accessed April 10, 2023, <https://www.census.gov/quickfacts/fact/table/US/INC110221#INC110221>.

case of Apple and \$1.36 in the case of Samsung. These are not fines for them that will punish criminal behavior, only relatively small fees that they have to pay, if they get caught, to continue abusing of planned obsolescence in their products. And, in all honesty, why would they act otherwise when the linear economy model of production is based on rewarding sales over sustainability? In this scenario, the logic option for them is to maintain planned obsolescence and keep making sales, which is what defines the success of a product.

### **Consumption and Waste Management of the Product**

The last two steps of linear economy are in the case of most products not pollutant in themselves. Carbon dioxide is not emitted to the atmosphere when one wears a T-shirt or a jacket, or when one writes on a piece of paper with a pen. However, once again the car industry is an example of a product that pollutes during its usage, so once again its impact needs to be discussed, even though for the rest of the products the impact on the environment of the act of using them is minimal to none. On the other hand, the last step, waste management, is important to discuss because it can and does affect the environment. At the very least, it alters it visually, and occasionally the waste itself can be harmful to the environment or human health. This is known as hazardous waste, and some examples of it are solvent-based paints, pesticides, batteries, motor oils, or medicines.<sup>100</sup> The fact that we even have a throwaway concept of waste is an indicator of

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<sup>100</sup> Department of Health & Human Services, “Hazardous Waste” (Department of Health & Human Services), accessed April 10, 2023, <http://www.betterhealth.vic.gov.au/health/healthyliving/hazardous-waste>; OLEM US EPA, “Learn the Basics of Hazardous Waste,” Overviews and Factsheets, November 25, 2015, <https://www.epa.gov/hw/learn-basics-hazardous-waste>.

how inefficient waste management systems are in linear economy models. A more suitable name for these practices is waste dumping or waste accumulation.

When it comes to the consumption or usage of the product, besides the planned obsolescence that was discussed earlier, what is worrisome is the use of those products that are generalized through the entire world population and that are pollutants. The car industry is the prime example of a product that does pollute when being used, and that many people have. As of 2022, there were 1.31 billion cars in the world, and it was expected that by 2050 there will be 2.21 billion vehicles, of which 31% will be powered by electricity.<sup>101</sup> That means that 1.52 billion cars will be constantly emitting carbon dioxide onto the atmosphere, and even if one may be inclined to think that the remainder 690 million electric vehicles will not be part of this problem while being used, charging their batteries implies the use of electricity that has to come from a certain source. The European Union has committed to achieve net-zero greenhouse gas emissions by 2050,<sup>102</sup> as well as the US in America's Zero Carbon Action Plan<sup>103</sup> and much of the rest of the world. If the plan follows, there could be a chance that the electricity needed to keep those cars is clean environmentally speaking. Still, the perspective of the very large number of vehicles that will still be emitting gases into the atmosphere is concerning and means that there must be planning made to retrieve greenhouse gases already in the

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<sup>101</sup> Jordan Wiklund, "Electric Vehicles Expected to Comprise 31% of the Global Fleet by 2050," January 12, 2022, <https://www.globalfleetmanagement.com/10159371/electric-vehicles-expected-to-comprise-31-of-the-global-fleet-by-2050>.

<sup>102</sup> European Commission, "2050 Long-Term Strategy," accessed April 10, 2023, [https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy\\_en](https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en).

<sup>103</sup> Sustainable Development Solutions Network, "America's Zero Carbon Action Plan," 9, accessed April 10, 2023, <https://www.unsdsn.org/Zero-Carbon-Action-Plan>.

atmosphere.<sup>104</sup> Ideally, we should be aiming for sub-zero emissions that allows to start making environmental reparations for all the damage caused to the atmosphere by over polluting the planet for decades.<sup>105</sup>

Regarding waste management, there are several reasons that concern this issue. The first one is related to how we are forced to handle hazardous waste. Not only it is problematic to deal with, but it also makes some of our most promising ideas regarding environmentalism become potentially almost as pollutant as our current linear economy model. Think of our beloved electric cars for instance. While in functioning they are more efficient, they demand far more materials than conventional cars, and many of those materials are hazardous waste. The following graph shows just how much more minerals are needed in the manufacture of electric vehicles.

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<sup>104</sup> Climate Council, “What Does Net Zero Emissions Mean? | Explainer,” Climate Council, accessed April 10, 2023, <https://www.climatecouncil.org.au/resources/what-does-net-zero-emissions-mean/>.

<sup>105</sup> Climate Council, “What Does Net Zero Emissions Mean?”



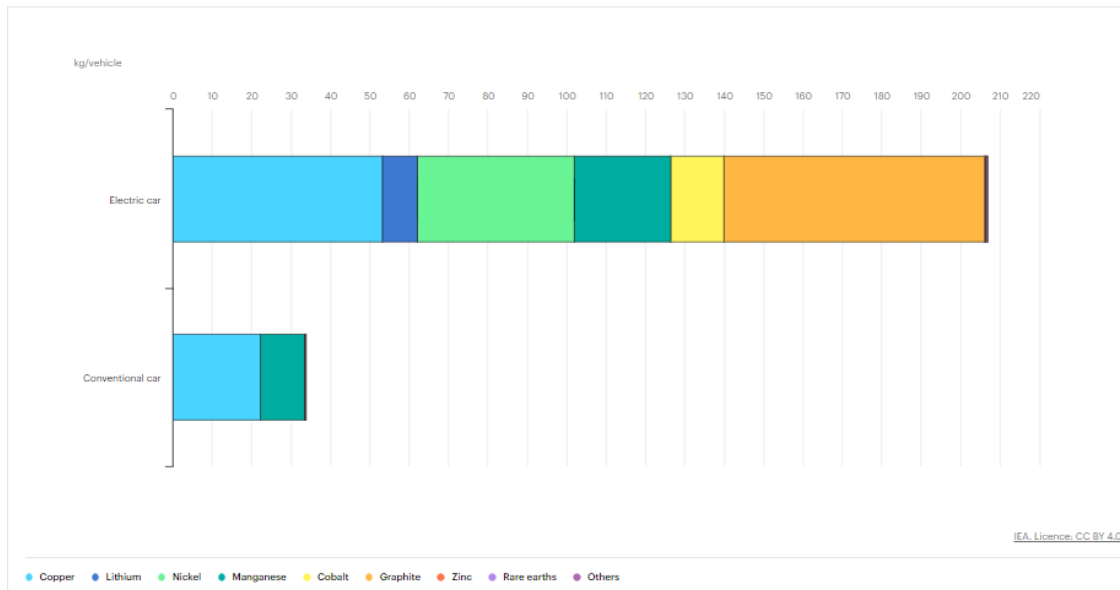


Fig. 8: Minerals used in electric cars compared to conventional cars<sup>106</sup>

Out of the materials needed to make an electric car, some of them are considered hazardous waste. This is the case of copper, lithium, manganese, and cobalt, which account for almost half of the minerals needed.<sup>107</sup> The case of the rare earth minerals is also remarkable. Although they are needed in very small quantities per vehicle, the extraction of these materials is much more inefficient and generates very large amounts of hazardous waste. For every ton of rare earth element, 2,000 tons of toxic waste are produced, including one ton of radioactive residue.<sup>108</sup> The ore of these rare earth elements is also often laced with radioactive thorium and uranium, which can produce especially

<sup>106</sup> “Minerals Used in Electric Cars Compared to Conventional Cars – Charts – Data & Statistics,” IEA, accessed April 10, 2023, <https://www.iea.org/data-and-statistics/charts/minerals-used-in-electric-cars-compared-to-conventional-cars>.

<sup>107</sup> New Jersey Department of Health, “Copper - Hazardous Substance Fact Sheet,” 2016, <https://nj.gov/health/eoh/rtkweb/documents/fs/0528.pdf>; “Transporting Lithium Batteries | PHMSA,” accessed April 11, 2023, <https://www.phmsa.dot.gov/lithiumbatteries>; Center for Disease Control and Prevention, “Toxicological Profile for Manganese,” n.d., <https://www.atsdr.cdc.gov/ToxProfiles/tp151-c1.pdf>; New Jersey Department of Health, “Cobalt- Hazardous Substance Fact Sheet,” 2005, <https://nj.gov/health/eoh/rtkweb/documents/fs/0520.pdf>.

<sup>108</sup> Jaya Nayar, “Not So ‘Green’ Technology: The Complicated Legacy of Rare Earth Mining,” Harvard International Review, August 12, 2021, <https://hir.harvard.edu/not-so-green-technology-the-complicated-legacy-of-rare-earth-mining/>.

detrimental health effects.<sup>109</sup> In terms of waste management and waste production, it seems like it may not be so clear that electric vehicles will be as key to environmentalism without a solution to the remarkably high costs of having to deal with such large amounts of hazardous waste.

Electric cars aside, all materials that are not hazardous waste eventually accumulate in dumpsters, meaning that the material turned into waste cannot be recovered anymore and is lost forever. Only a minority of the materials can actually be recycled. In Japan, it is estimated that only 21.7% of the materials are recycled, significantly lower than the government's targeted rate of 27%.<sup>110</sup> Moreover, there is a conceptual problem with the idea of recycling. When I, for example, need to change my phone because the processing chip is damaged and I cannot repair it for a reasonable price, the pieces that make the phone are disassembled and reduced to almost the way they were once extracted. This means that all of the materials need to be refined once again, despite the fact that except for the chip all the other pieces worked just fine. Recycling in itself is not a bad thing, but it is not actually saving as many resources as it is often thought because it does not allow for most steps to be reduced or stop happening altogether.

After having exposed some of the pollutant effects of linear economy, I will now proceed to explain how these translate to failures in fulfilling the political and philosophical conditions we considered of vital importance in chapter I.

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<sup>109</sup> Jaya Nayar, "Not So 'Green' Technology."

<sup>110</sup> Satoshi Honma and Jin-Li Hu, "Cost Efficiency of Recycling and Waste Disposal in Japan," *Journal of Cleaner Production* 284 (February 15, 2021): 125274, <https://doi.org/10.1016/j.jclepro.2020.125274>.

## **Linear Economy's Unfulfillment of Lockean Proviso**

The Lockean proviso, mentioned in chapter I, says that when one uses elements of public property, one must make sure that there is left enough and as good of whatever resource used that others are not impeded or restricted of its use.<sup>111</sup> This can be very directly related to the problem linear economy has brought to the table about scarcity of materials. The absurdly high levels of production that it forces the businesses to have in order to satisfy the market's demand for products is running the planet almost dry of its resources. In some cases, like cryolite, we have reached the point of giving up on using the natural version because making the synthetic substitute is cheaper despite the extra processing work that it takes to get it.

Linear economy fails to fulfill the Lockean proviso because it is unidirectional. Any linear process is dependent on some sort of flow that acts as the first input and leads to an end. When it comes to linear economy, it can be argued that there are two initial flows acting together, an energy flow that makes the machines work, and a material flow that brings the resources with which products are made. When the flow that initiates a linear process is halted, the process is bound to end. In the case of linear economy, perhaps the technology for renewable energies could be improved to the point that fossil fuels are not needed anymore, but in terms of the materials, no matter how efficient we get at making our products we will always need at least some of those materials. When they are finished, the system eventually breaks. In any economy, the principal problem is

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<sup>111</sup> Locke, *Second Treatise Of Government*, chap. V, section 33.

managing finite resources to fulfill infinite necessities, and this cannot happen with a process that is not designed to run infinitely.

Regarding the issue of environment, the Lockean proviso can still be applied even though things like the atmosphere are not explicitly used in the process of production because they still are public elements that we all use and are essential to our lives. Any amount of pollution that affects the environment negatively, short or long term, should not be tolerated under Locke's statement since it would not be as good as when it was previously being used. However, it may be possible that some low degree of pollution is inevitable, in which case in order to still act in the spirit of the Lockean proviso we should aim and put significant effort in staying as close as no emissions as possible. In linear economy models, the heavy machinery needed to produce essentially anything is forced to operate up to the very limit of its capacity, and in doing so it contributes to the degradation of the environment through greenhouse gas emissions among other forms of pollution.

### **Linear Economy's Unfulfillment of Maslow's Hierarchy of Needs**

Linear economy models assume that, following Maslow's Hierarchy of Needs, physiological and safety needs are taken for granted in their system because of the efficiency of their production processes. This is because they measure efficiency in monetary terms and speed terms. What any shift manager in a factory is trained to think first is how much the product costs to be made, and how quickly can the product reach the market. Once this is settled, the rest of the companies that are not in these sectors look to fulfill belongings and love needs, esteem needs, and/or self-actualization needs that are

not basic for us. The complexity of those needs is such that people often do not know what they know exactly, meaning they are subject to manipulation through advertising to buy things that they may not actually need, or simply affected by factors that are not logically tied to the purchase decisions we make. Roughly 25% of Americans regret purchases they made while experiencing significant stress.<sup>112</sup> In addition to that, often the customer preferences are just trends that change over time. Fashion is especially ruthless in that respect, with very fast-paced changes that can leave a company with large sums of inventory they cannot sell. Inditex, one of the leaders of this industry, compares it with selling fish. When the product is fresh it is easy to sell it for a high price, and after that period it becomes very hard to sell and it requires discounts.<sup>113</sup> This is why they innovated their supply chain design for their brands to make their products rotate easily and as quickly as 3-4 weeks for compared with the industry standard of 5-6 months.<sup>114</sup> This not only allows them to adapt to sudden changes very quickly and save them the costs of holding inventory, it also helps them create a sense of urgency in their clients. They know that, if they do not purchase something they like when they see it, it is likely that it will be gone forever after that.

The issue with these practices is that contrary to the assumptions made in a linear economy model, physiological and safety needs cannot be taken for granted once they are covered. Our activities in the economy can and do hurt the fulfillment of those needs.

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<sup>112</sup> Discover and Thrive Global, “Thriving Wallet. Research Insights Report/White Paper,” n.d., 7, <http://community.thriveglobal.com/wp-content/uploads/2020/02/Thriving-Wallet-Research-Insights-Report.pdf>.

<sup>113</sup> Md Afzalul Aftab et al., “Super Responsive Supply Chain: The Case of Spanish Fast Fashion Retailer Inditex-Zara,” *International Journal of Business and Management* 13, no. 5 (April 22, 2018): 214, <https://doi.org/10.5539/ijbm.v13n5p212>.

<sup>114</sup> Aftab et al., “Super Responsive Supply Chain,” 214.

Taking Inditex as an example, one can think that since they need to produce less because they make very significant efforts in avoiding manufacturing many clothes if they do not think they can sell them all. However, the logistical effort of keeping their stores supplied but not oversupplied that they need space for inventory translates into a lot of transportation being needed, much more than usual that it can truly affect our lives. More transportation means more greenhouse gas emissions being sent to the atmosphere, which means that it gets more and more affected and can begin to hurt some of our physiological needs, such as fresh air.

The loss of fulfillment of basic needs in order to meet higher-level needs is contrary to what Maslow's Hierarchy of Needs argues in principle, which is for a solidified, stable growth in society by fulfilling higher needs without compromising the more essential ones that are already fulfilled to a great extent. However, companies in the context of linear economy models are rewarded by acting against this principle, because the losses that they may face in the form of fees and loss of image are not outweighing the benefits of being able to cut financial costs and increase their profit margins when financial reports are what determines the success of a company.

### **Linear Economy's Unfulfillment of Game Theory**

In the study of both game theory and linear economy models, we tend to assume self-centeredness and rationality of choices, meaning that agents involved in them will put their own interests in front of everyone else's and act in the way that benefits them the most. Linear economy technically does that, on the assumption that financial success is the most relevant aspect of the company's activities. While that can make sense for

certain institutions, such as banks or stock trade investment firms, it is not worth it to companies that make tangible products. There is increasing evidence that business strategy focused on environmentalism is synonymous with improved returns, with very few studies finding negative relations between Environmental, Social, and Corporate Governance (ESG) and financial performance, both from the points of view of the investors and the companies.<sup>115</sup> The effects of these practices are especially relevant in the long term, even if they represent a financial and technological barrier for businesses in the short term that may force them to increase their prices in order to cover their costs. It is recognized to the point that Harvard offers degrees and graduate certificate programs in the area of sustainability.<sup>116</sup>

If these practices are beneficial, and the purpose of any business behind their decisions is their survival, then we must ask ourselves why all businesses are not investing in environmentalist technologies and processes. After all, they are better for the environment and better for the financial results, which means that it seems like a win-win. The problem here is that many businesses do not survive long-term. Half of the small businesses are less than 10 years old, 32 percent of them being less than 5 years old, and roughly a third of the new businesses exit at the two-year mark.<sup>117</sup> Even large corporations see their average lifespan significantly shortened. Even large companies are

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<sup>115</sup> Tensie Whelan et al., “ESG AND FINANCIAL PERFORMANCE:,” n.d., 4, [https://www.stern.nyu.edu/sites/default/files/assets/documents/NYU-RAM\\_ESG-Paper\\_2021%20Rev\\_0.pdf](https://www.stern.nyu.edu/sites/default/files/assets/documents/NYU-RAM_ESG-Paper_2021%20Rev_0.pdf).

<sup>116</sup> “What Is Sustainable Finance and Why Is It Important?,” Harvard Extension School, August 9, 2021, <https://extension.harvard.edu/blog/what-is-sustainable-finance-and-why-is-it-important/>; “Academics,” Harvard Extension School, accessed April 12, 2023, <https://extension.harvard.edu/academics/>; “Sustainability Master’s Degree Program,” Harvard Extension School, accessed April 12, 2023, <https://extension.harvard.edu/academics/programs/sustainability-graduate-program/>.

<sup>117</sup> “Small Business Longevity | JPMorgan Chase Institute,” accessed April 12, 2023, <https://www.jpmorganchase.com/institute/research/small-business/small-business-dashboard/longevity>.

seeing the effects of this trend as they are being outperformed by younger companies.

The median age of the top 10 S&P companies was 85 years old in 2000, and by 2018 the number had shrunk to 12<sup>118</sup> as start-ups have caught up and innovated the market to better serve the current customer requirements for their products. If the average age of the businesses is 5-10 years, how can it be expected that they make long term investments if they are costly and they may never see the benefits of them? Linear economy cannot help these companies make better decisions because it is focused on the immediacy of the fulfillment of demand. Small companies do not have the ability to do that and invest in the future, so they must choose between a quick buck or a potentially great financial game. Just like with humans, businesses have certain needs that must be covered to survive. In an economy of survival of the fittest, which is the case for even the most forward-thinking modern industries like IT,<sup>119</sup> these companies can barely survive as is, so they are forced to think short-term. On the other hand, larger companies will invest in research and development (R&D) to increase productivity and lower costs, but the second they find the scale economies they need, they become protective and do not have the need to invest in environmentalist practices because they are already leaders in the market and do not need to differentiate themselves from the rest any further.

In short, linear economy models do not necessarily enhance environmentalism even when it does enhance competition, which means that companies either are forced to

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<sup>118</sup> Philipp Hillenbrand et al., “Traditional Company, New Businesses: The Pairing That Can Ensure an Incumbent’s Survival,” 2019, 4, <https://www.mckinsey.com/~media/McKinsey/Industries/Electric%20Power%20and%20Natural%20Gas/Our%20Insights/Traditional%20company%20new%20businesses%20The%20pairing%20that%20can%20ensure%20an%20incumbents%20survival/Traditional-company-new-businesses-VF.pdf>.

<sup>119</sup> Guangshun Qiao, “Survival of the Fittest: The Long-Run Productivity Analysis of the Listed Information Technology Companies in the US Stock Market,” *Economics* 17, no. 1 (January 1, 2023), <https://doi.org/10.1515/econ-2022-0035>.



think in the short term or take protectionist measures to protect their advantageous competitive positions. Environmentalism just becomes an externality to deal with in the sufficient amount that it does not become a massive problem for the company rather than actively act in finding solutions that protect the environment. This sort of behavior is not what game theory would predict or require because it is a model that assumes rationality, and it is only rational that environmentalism becomes a critical factor on the verge of a climatic and ecologic crisis as large as the one that is predicted to be coming if as a society we do nothing about it.

### **Linear Economy's Unfulfillment of John Rawls' Politics**

John Rawls's idea of politics is based on equality of opportunities and freedom, and a willingness to compromise total equality for the sake of raising the floor of society as long there is reasonable mobility to allow for a chance for people at the bottom to rise to the top. Though linear economy models seem to at least need heavy involvement from people to increase productivity, leading to plenty of jobs that lift people that otherwise would be in the bottom of society, these jobs do not bring enough mobility between the top and the bottom and, much to Marx's concern, provoke a larger division between social classes.

One of the most common business strategy practices of multinational companies that partook in the linear economy model was the offshoring of manufacturing activities to developing countries. This practice allowed companies in the 1970s to take advantage of the fewer and more loose labor and environmental regulations of these countries to

maximize profits for their shareholders.<sup>120</sup> The extra expenses of shipping everything internationally were easily compensated for by the very significant cut in salaries and the fact that they had to spend less on Corporate Social Responsibility (CSR) practices.<sup>121</sup> This practice went on for decades, being financially profitable for businesses until the recent Covid-19 pandemic outbreak.

However, financial gain in this case did not align with either environmental or social causes that are relevant to Rawls' theory. On the one hand, the fewer environmental restrictions meant that companies had no incentive to invest any money more than necessary in cleaner alternative production processes. These companies would just have to do the bare minimum to be allowed to operate in the country. In fact, in the event that these companies did not even want to meet the environmental benchmarks given by the hosting country because it was not financially sound for them, the country would still be likely to give in and let them operate regardless to secure the jobs that the company's arrival would create. If we add this issue to the much more elevated emissions of gases involved in the shipping and transportation of products and materials all throughout the world, what we find is that environmentally wise these companies are polluting much more than if they kept everything local.

There is a common misconception about pollution because we tend to think that it is something that affects us all equally since we all live on planet Earth. In reality, there is no equality in harm even though pollution does harm everyone. The WHO says that their

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<sup>120</sup> Nick Stonnington, "Council Post: Why Reshoring U.S. Manufacturing Could Be The Wave Of The Future," *Forbes*, accessed April 12, 2023, <https://www.forbes.com/sites/forbesbusinesscouncil/2020/09/09/why-reshoring-us-manufacturing-could-be-the-wave-of-the-future/>.

<sup>121</sup> Stonnington, "Council Post."

data shows that even though the vast majority of the global population breathes air that exceeds their guidelines, it is low and middle-income countries that suffer the highest exposures.<sup>122</sup> It is also the poorer countries that, when efforts are made to reverse the situation, benefit the less from those efforts. While over 57% of the cities in the Americas and over 61% of the European cities had seen a fall in PM10 and PM2.5 matter in the 2010-2016 period, more than 70% of the cities in south and south-east Asia worsened their air quality.<sup>123</sup> The issue is what Banzhaf et al. refer to as “the ecological fallacy.”<sup>124</sup> We often analyze these issues by the size of entire cities and countries, and we do not necessarily see a correlation between pollution and average income or race, which makes us assume that everyone suffers from pollution equally. However, if we were to analyze the same data sorted by a more specific division, such as neighborhood, the stats would tell a different story which is more accurate with reality.<sup>125</sup>

A prime example would be the city of Chicago. It is one of the cities in America known to have made urban developmental plans by the use of redlining techniques that restricted black people to less developed neighborhoods that later on became ghettos, as American author and journalist Ta-Nehisi Coates mentions on his article *The Case for Reparations*.<sup>126</sup> It is also one of the US cities with worse air pollution.<sup>127</sup> However, when

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<sup>122</sup> “Air Pollution,” accessed April 12, 2023, <https://www.who.int/health-topics/air-pollution>.

<sup>123</sup> Jonathan Watts, “Air Pollution Inequality Widens between Rich and Poor Nations,” *The Guardian*, May 1, 2018, sec. Environment, <https://www.theguardian.com/environment/2018/may/01/air-pollution-inequality-widens-between-rich-and-poor-nations>.

<sup>124</sup> Spencer Banzhaf, Lala Ma, and Christopher Timmins, “Environmental Justice: The Economics of Race, Place, and Pollution,” *Journal of Economic Perspectives* 33, no. 1 (February 1, 2019): 191, <https://doi.org/10.1257/jep.33.1.185>.

<sup>125</sup> Banzhaf, Ma, and Timmins, “Environmental Justice,” 192.

<sup>126</sup> Ta-Nehisi Coates, “The Case for Reparations,” *The Atlantic*, May 22, 2014, <https://www.theatlantic.com/magazine/archive/2014/06/the-case-for-reparations/361631/>.

<sup>127</sup> Maxwell Evans, “Chicago Area’s Air Pollution Is Among The Worst In The US, New Analysis Finds,” *Block Club Chicago*, April 21, 2022, <https://blockclubchicago.org/2022/04/21/chicago-areas-air-pollution-is-among-the-worst-in-the-u-s-new-analysis-finds/>.

the pollution data of the city was analyzed in each neighborhood, there were specific neighborhoods that were more affected than others, and it so happened to be those neighborhoods that were poorer neighborhoods that coincidentally have the most households of color.<sup>128</sup> This is an environmental approach to a clear violation of Rawls' theory. There cannot be equal opportunities for all people if lower-income households suffer more from environmental issues that can provoke health problems in life that could be avoided. It also implies that perhaps the floor is not actually being raised in the progress of society, which means that there is no justification for inequality.

In terms of the distribution of money, the payoff is not even remotely equal either. The companies based in developed countries make significantly more money than the developing countries they offshore their processes in. A 2004 article by Diana Farrell, director of the McKinsey Global Institute, reveals that in the IT industry US workers make 10 times more money hourly than Indian workers.<sup>129</sup> Overall, the US made 78% of the new economic value created by offshoring, while India only made 22%.<sup>130</sup> McKinsey sees this situation as a win-win but fails to address that the gap between countries is growing wider and wider through these practices, which allows for problematic situations. India could become dependent of US offshoring because it does bring value to them, but the US has such an imbalanced power in the negotiation that they can squeeze

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<sup>128</sup> "Air Pollution in Chicago Area Impacts Communities of Color Most," ABC7 Chicago, October 25, 2021, <https://abc7chicago.com/chicago-air-quality-pollution-index-illinois/11167433/>; Sophie Yeo, "A Clever New Map Shows Which Chicago Neighborhoods Are Most at Risk From Pollution," Pacific Standard, January 15, 2019, <https://psmag.com/environment/which-chicago-neighborhoods-are-most-at-risk-from-pollution>; "In Chicago, Neighborhoods Have Stark Differences in Economic Opportunity," Urban Institute, February 1, 2022, <https://www.urban.org/urban-wire/chicago-neighborhoods-have-stark-differences-economic-opportunity>.

<sup>129</sup> Diana Farrell, "Who Wins in Offshoring," *International Herald Tribune*, February 7, 2004, <https://www.mckinsey.com/mgi/overview/in-the-news/who-wins-in-offshoring>.

<sup>130</sup> Diana Farrell, "Who Wins in Offshoring."

every cent India makes out of the trade to a minimum while they expand their gains to a point where Indian workers are almost slaves of US companies in comparison to US standards. This situation is also not in accordance with Rawls' theory because it cannot possibly create equal opportunities for everyone in the long run. The surplus of money that the US gets over India allows for an amount of growth that India cannot achieve with the money they make.

Having settled how linear economy models work and how they fail to fulfill what seems morally necessary for any economy, we are ready to introduce how circular economy works in comparison to it to highlight how it improves linear economy in sustainability and solves its problems.

## Chapter III: The Alternative of Circular Economy

Circular economy models are the next logical evolution of our production models to adapt to the problems that have appeared regarding our environment as a result of the overexploitation of the planet. The ideas behind this model are very simple in conceptual terms. If we cannot extract more materials from the Earth, then we should stop doing that. If we have been over polluting the atmosphere and the soil for a long time and it is starting to give people health problems, a solution must be found to not do that anymore. If we have waste made of materials that are forever unusable, but the cycle of nature does not have a concept of waste, then we should not have it either. It is easier said than done, but in principle it is logically easy to develop. It also assumes that, by nature, humanity is not ever fully satisfied. It always wants more things, new technologies, or new products, which means that it is not possible to have a satisfactory economic and social model that involves decreasing our standards of life. When we have things and they are taken away from us, we get upset about it, so nothing different can be expected about doing this at a large scale. Therefore, we need to find a way to decrease our environmental impact without compromising our standards of life.

The goal of this chapter is to find a sustainable model that fulfills all these things, and is in accordance with the principles extracted from chapter I. This chapter will explain the mechanisms at play of circular economy and address specifically how it is much more than mere recycling as many people mistakenly think when they are introduced to the concept, and how it is in fact a process that, while beneficial, is to be avoided whenever it is possible. After examining real-life cases from companies who

have adopted this model in their daily operations, I will propose a model for the implementation of circular economy models at a large scale, and explain how it fulfills the Lockean proviso, and stays in accordance with Maslow's Hierarchy of Needs, Game Theory, and John Rawls' politics. Lastly, I will address common criticism regarding the idea of circular economy.

### **Mechanisms of Circular Economy**

Circular economy models work under three main ideas or principles, as the Ellen MacArthur foundation puts it.<sup>131</sup> The first one is related to the idea of imitation of nature regarding waste management and pollution. There is no such thing as waste in nature; everything flows in a cycle, and the same goes for pollution. Everything is perfectly balanced for life to flourish. The understanding is that circular economy models should be no different than nature. Rather than exploiting nature the way linear economy does, circular economy models try to integrate themselves into nature and its cycle, removing or minimizing in the process all the negative externalities of production.

The second principle is the circulation of products and materials, which derives from the idea of imitating nature as well. If there is no waste in nature, as the first principle suggests, that can only happen either by making manufactured products last indefinitely, or by making the materials available to be reintroduced into the production cycle. In order to comply to this principle as much as possible, products must be

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<sup>131</sup> Ellen MacArthur Foundation, "The Circular Economy in Detail," accessed April 12, 2023, <https://emf-digital.shorthandstories.com/the-circular-economy-in-detail/>.

designed, in order of importance, durability, reuse, repair,<sup>132</sup> refurbishment,<sup>133</sup> remanufacturing,<sup>134</sup> and recycling.<sup>135</sup> In an ideal circular economy model, no new materials would be needed at all because all materials used in production would come from old products that are not usable anymore.

The third principle that governs circular economy models is the regeneration of nature. At the current moment in history, it is assumed that we have already harmed the planet due to our traditional linear economy models being inconsiderate of nature's fragile equilibrium. Aiming for net-zero emissions is a start, but it cannot end there. From a sustainability and environmentalist perspective, reparations to nature must be paid, which include plans to actively reverse the effects of human activity's impact on nature and responsibility of climate change. In order to comply with the timelines in carbon dioxide emissions agreed upon in the Paris Agreement that say that our emissions must peak before 2025 and drop over 40% by 2030,<sup>136</sup> which means that reparations are needed rather than just stopping to pollute. Currently there are already some projects on the table that can make significant impact by extracting carbon dioxide from the atmosphere. They are known as negative emissions technologies (NETs) and they include

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<sup>132</sup> Definition: rehabilitating existing products that malfunction so they do not malfunction anymore

<sup>133</sup> Definition: collecting products or materials that have been discarded and fix them so they can be used again for their original functions

<sup>134</sup> Definition: process to rebuild and recover previously sold, worn out, or dysfunctional products

<sup>135</sup> Definition: collecting and processing materials so they can be reused to make new products

<sup>136</sup> UNFCCC, "The Paris Agreement," accessed April 12, 2023, [https://unfccc.int/process-and-meetings/the-paris-agreement?gclid=CjwKCAjwrDmhBhBBEiwA4Hx5g6LTwHJwCHRmXOi3LtTZRk\\_PmDAuqXFfa154CL9t5o5joYh4JWUJI8hoChpsQAvD\\_BwE](https://unfccc.int/process-and-meetings/the-paris-agreement?gclid=CjwKCAjwrDmhBhBBEiwA4Hx5g6LTwHJwCHRmXOi3LtTZRk_PmDAuqXFfa154CL9t5o5joYh4JWUJI8hoChpsQAvD_BwE).



already applicable techniques such as reforestation, afforestation, and agricultural and coastal management practices to add carbon to soils and sediments.<sup>137</sup>

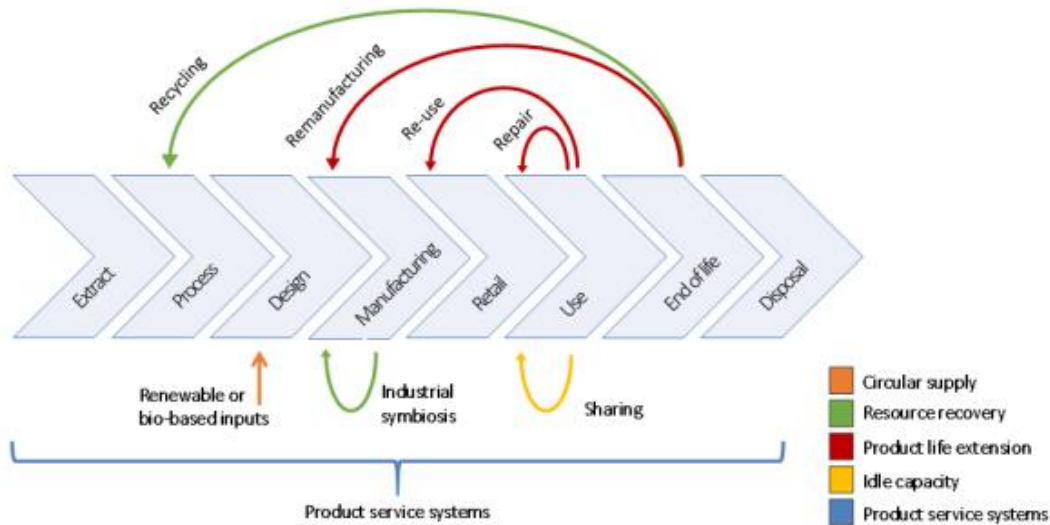
The idea, starting from the initial linear economy, is to skip as many of those steps that are a part of it as possible. Circular economy models are based on the belief that the fewer human activities are performed, the less impact our existence and lifestyle have on the environment. Humanity should not only strive for progress but should do so by interfering the least possible with nature and by making the least number of moves and decisions possible, allowing for nature to run its course. In some ways, circular economy models have similarities with Lao Tzu's *Tao Te Ching*. In this text, Lao Tzu introduces us to the concept of the Tao, which is ineffable but seems to refer to how things in nature flow naturally in harmony without the need of our intervention, and we should therefore not interfere with it. We could not say when or if nature does anything in the world, yet all things happen within nature. "The Tao in its regular course does nothing (for the sake of doing it), and so there is nothing which it does not do."<sup>138</sup> Circular economy models can be seen as the materialistic approach to the Tao, which goes through redefining our production processes to be the least interventionist possible on the flow of these materials and nature in general terms.

The following chart shows the relationship of all actions and steps of the production process in circular economy models.

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<sup>137</sup> David Kramer, "Negative Carbon Dioxide Emissions," *Physics Today* 73, no. 1 (January 1, 2020): 46, <https://doi.org/10.1063/PT.3.4389>.

<sup>138</sup> Lao Tzu, *Tao Te Ching*, ed. Gregory Walker and David Widger (Project Gutenberg, 2013), [https://www.gutenberg.org/files/216/216-h/216-h.htm#link2H\\_PART](https://www.gutenberg.org/files/216/216-h/216-h.htm#link2H_PART).



Source: (OECD, 2019<sup>[32]</sup>)

Fig 9: The circular economy model<sup>139</sup>

### The Fallacy of Recycling

As you may have noticed in the chart above and in my description of the most important goals from a design perspective of the products and materials that are used in them, recycling occupies the last place in the list of priorities. Despite common misconceptions, circular economy goes much deeper than merely extreme forms and processes to enhance recycling. This is because recycling is not a process that increases efficiency of the usage of materials as well as other methods.

One of the reasons for this lack of efficiency is that recycling is not skipping many of the steps needed compared to the linear economy model of production. As figure 9 shows, recycling only goes so far into skipping processes by skipping the extraction

<sup>139</sup> OECD, “Towards a More Resource-Efficient and Circular Economy. The Role of the G20,” 2021, 25, <https://www.oecd.org/environment/waste/OECD-G20-Towards-a-more-Resource-Efficient-and-Circular-Economy.pdf>.

stage, but the materials recycled still must be processed, manufactured, and assembled before they are back in the market again. In practice, if I were to recycle my entire phone because it is broken beyond repair, all the materials of the phone would be blended and then all the pieces would have to be manufactured and assembled again into a new product. This would not be ideal, mainly because the phone may have had some pieces that could have been directly reused to repair another phone, therefore more actions than needed would have been taken to reintroduce the materials, which means more gas emissions are sent into the atmosphere.

On top of that, there are certain materials that are especially hard to recycle because they require complex processes to isolate the base materials that can be reintroduced into the process. Even without that, having to recycle materials involves degrading the qualities of them and potentially disposing of the parts of them that are not fit to be reintroduced into the cycle. This is the case of plastics, for example. Despite these materials being one of the most popular materials to be recycled, the reality is that the way they are made, by mixing chemicals, makes it very hard to isolate the base materials that can be recovered, which is why only 5-6% of the US' plastic waste for 2021 was converted into new products.<sup>140</sup> Even though claims have been made about the success of chemical recycling, conflicts of interest by the organizations publishing these results, and contradicting reports that show enough evidence to say that it is just another way of disposal that produces carbon emissions make them very questionable at best.<sup>141</sup>

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<sup>140</sup> Christopher Marquis, "Beyond Plastics: The Myths And Truths About Recycling, And Potential Solutions," *Forbes*, July 12, 2022, <https://www.forbes.com/sites/christophermarquis/2022/07/12/beyond-plastics-the-myths-and-truths-about-recycling-and-potential-solutions/>.

<sup>141</sup> Marquis, "Beyond Plastics"; Judith Enck Dell Jan, "Plastic Recycling Doesn't Work and Will Never Work," *The Atlantic*, May 30, 2022, <https://www.theatlantic.com/ideas/archive/2022/05/single-use-plastic-chemical-recycling-disposal/661141/>.

Since that step, disposal, is the one that in circular economies we want to avoid as much as possible, circular economy models should look into finding ways of implementing steps that are more simple and retain more value of the materials or the product, such as repairing or reusing.

For all these reasons, companies that invest in implementing circular economy models should focus on implementing value-retention processes, or VRPs, to not just reintroduce the material, but to have them with the added value of having already been through the steps of assembly and manufacturing when possible. The shorter the loop is, meaning the closest we reintroduce the product back to the consumer, the more production steps are skipped, which means less emissions to the atmosphere and less of the utility of the product or the materials is potentially lost.

It is also worth noting that investing in VRPs opens a potential door to the problem of automation. According to a report made by the International Research Panel at the UN, there is potential for significant future employment opportunity in the areas of remanufacturing, refurbishment, and repair of products. The following charts show how these employment opportunities do not just come at a very significant rate but also at a fraction of the cost of using new products constantly for the case study of industrial digital printers.

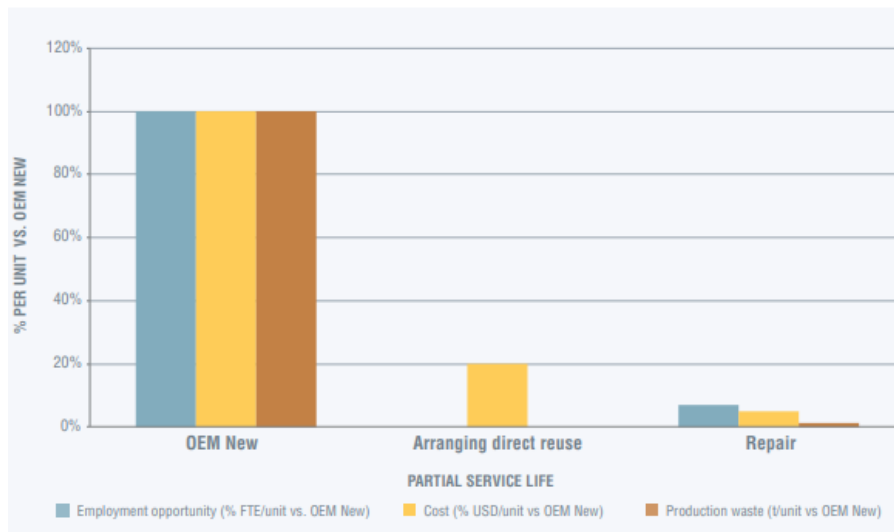
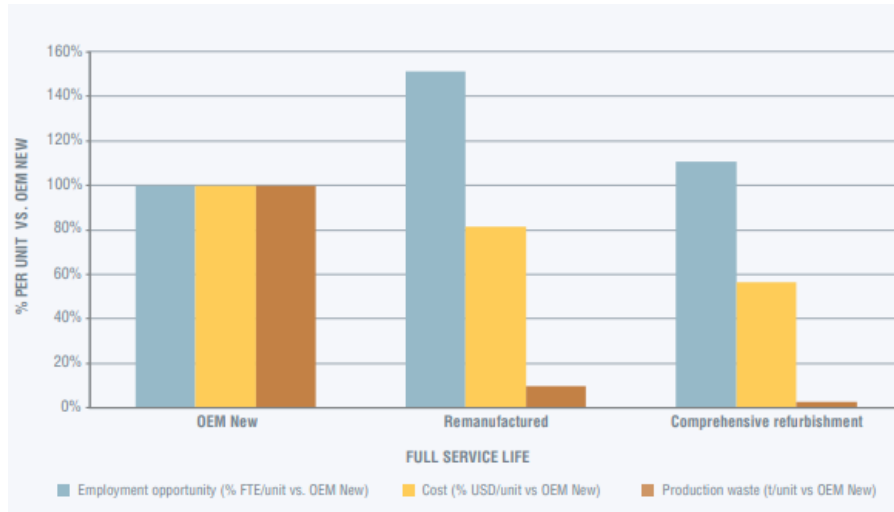


Fig. 10 and 11: Employment opportunity at different VRPs<sup>142</sup>

These charts show that, for the processes of remanufacturing and refurbishment, there are large employment opportunities for a lower cost than producing strictly using new materials, and all that with a remarkably low amount of waste involved. These metrics suggest that these VRPs could be potential employment destinations for those

<sup>142</sup> Jennifer Dianne Russell, Nabil Z Nasr, and UNEP International Resource Panel, “Re-Defining Value - The Manufacturing Revolution: Remanufacturing, Refurbishment, Repair and Direct Reuse in the Circular Economy,” 2018, <https://doi.org/10.13140/RG.2.2.31020.00640>.

who may be out of a job because of the expansion of automation into their professions. In the case of reuse and repair, the employment opportunity is much smaller, or none in the case of direct reuse, but it still makes sense to invest in them from a cost efficiency and waste management standpoint. Overall, investing in VRPs seems to expand the demand for human labor in companies despite automation, and all for a fraction of the cost of producing strictly using newly extracted materials.

### **Real-Life Circular Economy Case Studies: Renault and Apeel**

An example of a company that has implemented circular economy practices in an industry that often needs to use heavy machinery is French automobile manufacturer Renault. Through remanufacturing vehicle components to make old pieces perform as close to new pieces as possible, increasing recycled plastic content and creating a second life for electric batteries, their results have been very positive. Since 2012, 60% of gearboxes, 60 to 70% of engines and 40% of turbos have had their components renovated.<sup>143</sup> The energy they save for every remanufactured component is very significant too. For every remanufactured component, they use 80% less energy, 88% less water, 92% less chemical products, and produce 70% less waste currently.<sup>144</sup> In their short-term plans, they are developing a new “re-factory” at Flins, France, that will support circular economy innovation, and their longer plans include creating mobility solutions with negative CO<sub>2</sub> balance by 2030 and creating 3000 new jobs.<sup>145</sup> Their turnover from the use of circular economy practices exceeds \$500M per year,<sup>146</sup>

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<sup>143</sup> Ellen MacArthur Foundation, “Europe’s First Circular Economy Factory for Vehicles: Renault,” accessed November 22, 2021, <https://ellenmacarthurfoundation.org/circular-examples/groupe-renault>.

<sup>144</sup> Ellen MacArthur Foundation, “Europe’s First Circular Economy Factory for Vehicles.”

<sup>145</sup> Ellen MacArthur Foundation, “Europe’s First Circular Economy Factory for Vehicles.”

<sup>146</sup> Ellen MacArthur Foundation, “Europe’s First Circular Economy Factory for Vehicles.”

exemplifying how from the companies' standpoint it is a direction that they can go to and still be profitable in doing so.

Renault has also entered strategic partnerships with Veolia and Solvay to establish closed-loop cycles of reuse and recycle of lithium-ion batteries for their electric vehicles. The partnership seeks to set up a sustainable supply source for key battery metals such as cobalt, nickel, and lithium, reduce the environmental footprint of future batteries, prioritize short loops, and reduce financial production costs.<sup>147</sup> The partners are already engaged in an experimental phase which involves setting up a demo plant in France with “with the capability to extract and purify end-of-life EV battery metals.”<sup>148</sup> By way of these partnerships that Renault has been making in their bid for circular economy, they will surely expect to be one of the main players in the industry of electric vehicles. Their commitment to the ideal of circular economy and their investments in R&D could potentially give them a significant competitive advantage over their rivals, on top of being beneficial for everyone else in terms of getting a better product which also pollutes less in the making, helping the environment recover from our abuse of it over the past decades.

Another company that has been relevant in their approach to circular economy is Apeel. They have developed a product that has the potential to end the use of single-use plastic packages by observing nature and finding a way to imitate it. Plants have a

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<sup>147</sup> “The Circular Economy of the Electric Car Battery - Renault Group,” accessed April 13, 2023, <https://www.renaultgroup.com/en/news-on-air/news/the-circular-economy-of-the-electric-vehicle-battery/>; “Renault Joins Veolia and Solvay in the EV Battery Recycling Consortium,” Solvay, March 18, 2021, <https://www.solvay.com/en/press-release/groupe-renault-veolia-solvay-join-forces-to-recycle-end-life-ev-battery-metals>.

<sup>148</sup> “Renault Joins Veolia and Solvay in the EV Battery Recycling Consortium.”

protective layer around them that allows them to breathe without drying them out.

Apeel's product imitates them in features and materials, using natural compounds found in various foods, which does not just make the product biodegradable, it also makes it even edible.<sup>149</sup> It is invisible, odorless, and tasteless, meaning that if you have had fruits or vegetables in the US, you may have already eaten this protective coat without realizing at all.

The performance of the product is remarkable. Avocados last 2-3 days longer at their peak of maturity.<sup>150</sup> That may not sound like a lot, but it is important. Farmers can harvest their produce before maturity, knowing well that the product will reach maturity without drying out inside a hermetic plastic wrap, and they also last longer at peak of maturity, which helps people at their homes manage their food properly. In a world in which the US alone generates 103 million tons of food waste per year,<sup>151</sup> a couple of extra days to use the product at its best moment can really make a difference.

These are all great examples of using circular economy models for business profit and better service to the community. The question now is how to make this work on a global scale and make these practices ordinary.

## **Implementation of Circular Economy**

A model of circular economy that I could see working would have to be based on the idea that companies should really have no other logical option for sticking to linear

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<sup>149</sup> "How Apeel Works | Learning From Nature | Apeel," How Apeel Works | Learning From Nature | Apeel, accessed April 13, 2023, <https://www.apeel.com/how-apeel-works>.

<sup>150</sup> "Longer-Lasting Avocados | Products | Apeel | Apeel," Longer-Lasting Avocados | Products | Apeel | Apeel, accessed April 13, 2023, <https://www.apeel.com/products/longer-lasting-avocados>.

<sup>151</sup> Martina Igini, "10 Food Waste Statistics in America," Earth.Org, November 23, 2022, <https://earth.org/food-waste-in-america/>.



economy models. Part of the way to get to this goal has to do with policy making. Practices that go in the opposite direction of circular economy should be heavily punished already at this stage,<sup>152</sup> such as Apple and Samsung's planned obsolescence implementation on their models. The base of these sanctions should be solid and made to detract companies to do similar things. They should be exemplary sanctions and disciplinary, so that the tone is set to establish the direction in which we want to go regarding our economy.

Future regulations will have to adapt to our findings in the upcoming years in the sustainability area, to make progressively more restrictive policies that punish linear economy models. For example, the arrival of electric vehicles into the market at a large scale would not have been foreseen many years ago as an option for sustainability, perhaps because sustainability itself was not even a concern back in the 20<sup>th</sup> century, but that has significantly changed. From 2035 onwards, the EU will ban cars that emit carbon dioxide,<sup>153</sup> meaning that it is very likely that most cars are electric from then on. Other policies that have been happening lately in favor of circular economy are action plans for the implementation of a circular economy in the future, with special emphasis on reducing carbon emissions and optimizing the use of energy.<sup>154</sup> Policy making, although

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<sup>152</sup> The entities that have the power to implement these penalties or sanctions are national and international public judicial institutions, such as the Court of Justice of the European Union or the Supreme Court in the US. United Nations could be the main supranational judicial institution if it were independent to at least impose heavy financial sanctions, but the veto power of some members makes it politically inadequate in the current situation.

<sup>153</sup> "EU Ban on Sale of New Petrol and Diesel Cars from 2035 Explained | News | European Parliament," March 11, 2022, <https://www.europarl.europa.eu/news/en/headlines/economy/20221019STO44572/eu-ban-on-sale-of-new-petrol-and-diesel-cars-from-2035-explained>.

<sup>154</sup> Thiago A. C. de Melo et al., "Circular Economy Public Policies: A Systematic Literature Review," *Procedia Computer Science*, International Conference on Industry Sciences and Computer Science Innovation, 204 (January 1, 2022): 659, <https://doi.org/10.1016/j.procs.2022.08.079>.

vague still, is consistent among different countries in that aspect. Research shows that regulations are a significant factor for those companies who have implemented circular economy models despite it not being perceived as important by those who have not implemented it yet.<sup>155</sup> I believe, therefore, that being more specific and restrictive in what is and is not allowed or encouraged for the sake of circular economy is important to motivate companies and societies to begin their transition.

In a more practical way, the businesses need to be sure that they can get the materials back from the clients in order to implement circular economy models for their production and distribution of goods and materials. They also need to have a system in which they can still make regular sales to the customers, which on paper seems contradictory to extending the product's usage life. A possible solution would be that one of the VRPs that the companies begin to target is the upgradeability of the products. When a company launches a phone, it does not launch a new one with slightly better features. Instead, the company invests in developing only the new features, then launches them as extras that people would buy by going to the store and asking for them to install it easily into their phones as if it were a repairment. The businesses would only have to develop parts of the phone, not the full version, so they would be saving money. The customers would still get the option of regular updates without necessarily entering a spiral of headless consumerism.

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<sup>155</sup> Concepción Garcés-Ayerbe et al., "Is It Possible to Change from a Linear to a Circular Economy? An Overview of Opportunities and Barriers for European Small and Medium-Sized Enterprise Companies," *International Journal of Environmental Research and Public Health* 16, no. 5 (March 2019): 851, <https://doi.org/10.3390/ijerph16050851>.

Regarding the return of materials, an idea that could work is an open market for reusable and recyclable products. When a customer's products are broken beyond repair, the owner would have the opportunity to sell the products back to the companies that would make their purchasing offers to them. This way, the owner of the product would choose the best deal for the materials of the product, which could be in the form of a payment or a discount for their next purchase. In this scenario, the materials would go back to the companies, but they would have to compete for those new materials, which would be much cheaper than the extraction of new virgin materials. There would always be competition among companies at least in that end, and in order to be able to offer the best deals to clients while maintaining profitability, a constant R&D investment race for efficiency and better products would be happening in every industry because all of them would have to rely on getting the products back.

Companies can also rely on other forms of payment for services that are ongoing, such as the subscription model, to ensure an ongoing cash flow going their way. An example to do this efficiently in the context of a circular economy model is the mobility apps, such as Lyft, or carpooling apps like Blablacar. Blablacar basically works by connecting drivers and passengers that need to go to roughly the same place, so they drive together and share costs. Lyft does not require of explicit sharing of vehicles, but it functions by having a float of cars or other vehicles in a large metropolitan area available to drivers that would just rent them for the drive from A to B. Make these vehicles electric, or mechanical like a normal bicycle if the city's layout and elevation changes allows for that, and you would have a service that would work fantastically in the city. If it becomes big enough, and it is complemented by public transportation too, there is no

reason for people in the city to own their own car and commute with it to work, therefore reducing the amount of vehicles needed and reducing the car emissions even further. This would also include the assumption that electric sources of energy are renewable to avoid greenhouse gas emissions all through the chain.

Now that we have established the basic attributes of circular economy, we can discuss how it fulfills the most relevant philosophical and political aspects of vital importance of chapter I.

### **Circular Economy's Fulfillment of Lockean Proviso**

In principle, circular economy aligns with the Lockean proviso perfectly. It leaves enough and as good of whatever is used in production for others to use, because it uses the exact same things repeatedly. In a closed loop environment, this would solve the scarcity of resources that we have in the linear economy and was so problematic in this point. However, even the most optimistic of circular economy models admit that there is some space for disposal whether it is because the product is deteriorated or because it just gets lost and does not make it back into the cycle, which means that at some point extraction still needs to happen. This would break the cycle of virtue that circular economy models design, but the rate at which this would have to happen is so slow that it should be irrelevant to the Lockean proviso in most instances.

It could be argued that the capacity to extract materials, and especially rare materials, could be compromised. If the extraction of materials is not efficient anymore as a part of a sustainable, successful business, then no companies would focus on extracting anything, the tools and expertise would be lost, and when we do need to

extract materials, we would not be able to, leading to running out of them which would lead to lower standards of living. This argument is made on the premise that circular economy models are not hermetically closed, which means that there is still some level of waste involved in circular economy by mere technological limitations that cannot be properly addressed. This tendency to linearity of circular economy models is a legitimate concern, which is why companies would ultimately keep their tools and extraction expertise in the first place. What would change is the scale and intensity of the step of extraction. Companies would not actually stop mining, they would just do it at a much slower pace, to a point in which ideally nature regenerates the materials faster than we use them, which would mean that the loop is fully closed when nature is counted in as a factor.

Another issue that can happen in circular economy models with the Lockean proviso is that customers could potentially hold onto their products when they are broken beyond repair to wait for higher offers from companies that need their product to survive. I believe that, just like I argued earlier, that if planned obsolescence would be a direct attack to circular economy, this kind of behavior would do the same, therefore it would need to be punished accordingly.

On the grounds of the Lockean proviso, it could be interesting to propose a duality of the concept of property of products. It could be argued that, since the materials are going through the cycle repeatedly, they cannot be anyone's private property because in the best-case scenario it is just your turn to use those materials. However, when a customer purchases a product, that product is undoubtedly theirs to use, and if someone took it from him that would be an act of stealing. This means that what you buy in a store

is what you value in the product, which is its functionality. One is the owner of a product as a whole in this scenario for as long as the product is functional or can be repaired to be functional. For example, I am the owner of my phone, but the chip and the screen are public ownership. Under these pretenses, it would be reasonable if someone destroyed an object by burning it to punish him with the law in hand, for he would be destroying or damaging public property. It would also be reasonable to penalize holding off onto a broken product for longer than necessary because he would be obstructing the public from making use of their public property. In the case of certain products whose value is a mix of function and material, like a house, not owning the materials may mean that home prices plummet, which would be counterproductive if we think of how important home prices are now and that it can mean heavy financial loss for some. In practicality, if all home prices drop, that just makes the market more accessible for everyone, and the practices for buying a house at first would not necessarily be that different. People would still sell their old houses to buy new ones if they needed to move, this time due to practicality more than strict financial restrictions. At worst, the prices would adjust naturally to compensate for demand changes even if the materials are not part of the equation necessarily, meaning house prices would not really change, only the reasons why we value houses higher or lower.

However, if the materials for the products are public ownership, why would companies have to pay for them to individual people? Since we are aiming for durability as the first VRP of the products and materials, we would be disappointed when the product stops working, and even more so if it stops working earlier than usual. We could have the assumption or expectation in our economy that all products should last forever,

therefore the payment is some sort of fee to pay when the product fails. It would have to be progressively lower as time passes from the moment of purchase, and variable depending on the price of the product. This rule to maintain Lockean proviso and consistency with all else would be nice also to promote that companies do invest in R&D for the larger durability of their products to have to pay lower fines.

### **Circular Economy's Fulfillment of Maslow's Hierarchy of Needs**

Circular economy models would align with Maslow's Hierarchy of Needs because it maintains the main principle of it. Maslow's Hierarchy of Needs is based on the idea that, even if the levels of it are not entirely inseparable, lower levels of needs must be essentially fulfilled to fulfill higher levels of needs. By promoting renewable energies, NETs, and revising processes that allow for materials that are finite or even scarce to not even have to be extracted in the first place, or to not have to be extracted as fast.

These ideas would mean that the basic needs of the hierarchy, which are physiological and safety needs, would not just be still essentially fulfilled, but it would solidify that basis further. Air pollution would not be there if we only used renewables. There would also be no scarcity of the most common materials because of the constant rotation around the cycle that they would do.

### **Circular Economy's Fulfillment of Game Theory**

In terms of what we talked about in game theory regarding linear economy models, this is the complete opposite of it. Not only do we assume rationality, given the situation graphed on figure 7 back in chapter I, but we find the Nash's equilibrium in it,

and exploit it for a true win-win situation. The customers get better, more durable products that are significantly cheaper in the long-term, and more financing options through the payback clause for the materials of their old items. The businesses have lowered their costs very significantly, which means that their amount of risk is reduced. On top of all that, the environment is not being polluted anymore, and with the idea of NETs becoming a reality soon if technology allows for it, the state of our environment should be improved.

### **Circular Economy's Fulfillment of John Rawls' Theory**

From an environmentalist perspective, John Rawls' theory is fulfilled in circular economy if there are significant improvements in the recovery of the environment for the lower-income communities as much as there is in the higher-income communities. The important thing is to raise the floor, and circular economy models help with that in the environment, assuming that the most affected environmental areas would notice signs of improvement first.

From a social perspective, circular economy models can lay the groundwork for equality of opportunities for everyone. The higher demand of jobs in circular economy due to the arrival of new employment related to circular economy's VRPs are good opportunities for people who are unemployed, have precarious jobs, or have their jobs in danger due to the arrival of automation, despite the admittedly growth of this feature also in circular economic models. Also, since the advantage of offshoring would not happen due to the large increases in the cost of transportation given that the circular economy



models would not approve of such large expenses, people would assume that the hiring would be more local and less precarious in that aspect.

It can be argued that the mere creation of jobs does not necessarily eliminate or reduce disparity, especially between rich and poor countries. In relation to that, it is important to note that in today's economic landscape, many of the countries that are poor financially speaking are often rich in natural resources of some sort, especially in Africa and Asia. On a global scale, the creation of jobs in these countries that are focused on making that scarce material last longer gives them more power. If they not only extract the material (which would happen at a much lower scale), but they also work on recovering that material from the products it can be found on, then their competitive advantage as suppliers is larger and more sustainable in contrast to the more developed countries that are generally not as rich in natural resources because they have already been exploited and made waste.

It makes sense that solutions to social and environmental problems feed off of each other because of the interconnectedness of John Rawls' theory with politics in a direct way, and with environmentalism in an indirect way, as an indicator of social inequality.

### **Technical and Political Critiques of Circular Economy**

The following critiques of circular economy models have one thing in common. They are all focused on the idea that circular economy models underestimate the challenge of truly trying to be one with nature.

The first one is related to the concept of dissipation and entropy, or chaos, provoking leaks of either energy or material that cannot be overcome unless new material is put in, which makes the system ultimately linear.<sup>156</sup> In terms of energy, if we switch to renewable energy sources that should not ever be a problem at all. On the other hand, in terms of materials, the fact that circular economy models are not as infinite as initially thought, I believe that it is still not a reason not to introduce circular economy models because even if they tend to linearity, they still have potential to be incredibly efficient, much more than traditional linear economies. I will admit though, that the long-term viability of circular economy models may be subject to their level of efficiency. If they are not using resources at a slower speed than they regenerate, then we have done nothing.

Another critique is related to the “waste market.”<sup>157</sup> There is worry about the volatility of the waste and recycling markets because they would be unpredictable, but I believe they would in fact be relatively predictable. They have a broken product and a need to replace it, and they cannot wait too long and hold the materials because they do not own those, as per the Lockean proviso, which means that they have not a lot of time to think about who to buy or for how much money. If it is about complying with circular economy, the risk of loss or an accident can happen anywhere, linear economy or not, and given the scarcity of materials provoked by linear economy, me crashing my car into a bridge is not something to care about much from a material perspective because the problem of totaling a car in both of those situations is significant. In linear economy, I am

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<sup>156</sup> Hervé Corvellec, Alison F. Stowell, and Nils Johansson, “Critiques of the Circular Economy,” *Journal of Industrial Ecology* 26, no. 2 (2022): 423, <https://doi.org/10.1111/jiec.13187>.

<sup>157</sup> Corvellec, Stowell, and Johansson, “Critiques of the Circular Economy,” 423.

going to demand a car with all that it implies in environmental impact. In circular economy, the car's materials will be unusable except for maybe recycling, which means that I will not be able to skip many steps on the production of the new car.

The last critique is related to the idea that the implementation of circular economy is unclear because it only chases material ambitions about the world and not social justice or environmental protection. However, the whole reason to implement circular economy is to protect the environment, otherwise we would stay using linear economy and not bother. Regarding the social justice item, I believe that in the parallelism with John Rawls and the creation of jobs as one of the reasons to implement circular economy there is enough answer to that justification in this thesis and the model it proposes to make it function globally.

### **Ethical Critique of Circular Economy: Objects with Sentimental Value**

A possible philosophical counterargument against the idea of circular economy models is that it is ethically not complete. While it is relatively simple to understand the utilitarian value of circular economy models, it is not as clear how the use of these is an improvement ethically from deontologist and virtue ethics. This is especially relevant for instances in which the value of the products to us does not come from a utilitarian point of view, but from a sentimental point of view. An example could be the houses and furniture that we inherit from our loved ones. Art or literature of any kind can also be included in this group. While it is understandable that, if I am not going to use a wooden bedframe that a loved one used to own, I should either resell it or reintroduce the materials into the market in some other way at least as soon as possible, something is not

right with having to do that before grieving it. And it would be a very tough task to explain why we would destroy Aristotle's original texts to use the paper for something as banal as a guide to set up your own TV channels.

My proposal is to award any object that we hold sentimental value to the gift of life. It may sound strange to recognize these objects as such, but once we make distinctions between the utility of the product and the materials it is made of in terms of property it does not necessarily sound much more different than how we think of humans in transplants. We treat all the people as an end, and when catastrophes like car crashes happen, we do our best to save everyone's lives if we can help it. However, in hospitals, when someone does die their bodies and organs become a means to save someone's life through transplants or similar practices. Even though there must be consent either by the deceased person through being listed as organ donor, or by the respective loved one, it is an acceptable question to ask because the deceased is not a person anymore, just a corpse. To some extent, the significance of the sacredness of their body is gone when their life is no more.

My proposal, therefore, is to distinguish between these two stages in the life of a product. Those products that hold sentimental value and utilitarian value would be considered alive, whereas those that are not considered valuable anymore would be considered dead. If we did that, we would be able to still apply the concepts of utilitarianism without being insensible to the sacredness of certain objects that hold value to us. All we would need to do is insert a ritual of death of the objects, as if it were a funeral, to truly respect this passage should it need to be done. If we attribute life to

objects, and we assume that they can die, then it would make sense to have them as a way to obtain closure and formalize the reintroduction of all objects' materials into the cycle.

This proposal is in fact mentioned by American author Ursula K. Le Guin in her novella *Paradises Lost*. In this story, the characters are all in a spaceship in one of those kinds of space missions that have been suggested that may be needed in the future and will take more than one generation traveling in the spaceship in order to explore other galaxies, in this case in the search of a new inhabitable planet. In order to create a sustainable ecosystem in space, they need to create a closed loop environment, and in order to achieve so, every last thing gets reintroduced into the cycle. All objects and beings, including humans, transition after death to stay a part of this closed environment. When there is a funeral for one of the humans who died, her remains are reused and recycled at a Life Center. This closes the loop, allows for closure, and preserves the environment. It also brings great dignity to the concept of death and explains what comes after in a certain idea of reincarnation and eternal servitude to the community. "She would still be part of their world, not as a being but as an endless becoming. She would be part of the children Hsing would bear. They were all part of one another. All used and users, all eaters, all eaten."<sup>158</sup> From the perspective of objects, the idea of the funeral applies similarly, though it is not specified when an object dies. "No inessential artifact could survive more than a few years. Clothes, artworks, paper copies of texts, toys, all were given back to the cycle, sometimes with a ceremony of grief."<sup>159</sup> The question is, how does this align with ethical views that are not utilitarian?

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<sup>158</sup> Ursula K. Le Guin, "Paradises Lost," in *The Birthday of the World And Other Stories* (HarperCollins Publishers, 2002), 262.

<sup>159</sup> Ursula K. Le Guin, "Paradises Lost," 288.

Deontologist theories are based on the idea that the moral reasons to do certain actions respond to specific criteria, or rules. What makes a choice right is its conformity with the norm, regardless of the good consequences of the action itself.<sup>160</sup> In order for this kind of practice to be allowed in circular economy models, or for circular economy models in general to exist, a generalizable rule must be created as a moral imperative that justifies it being applied in all pertinent cases. However, these generalizable rules must come from somewhere. John Hooker uses a kind of deontological approach to talk about business ethics, introducing the principle of generalization as a test to decide whether an action or decision is ethical or unethical. He argues that an action can be generalizable if the actions for doing so are consistent and coherent, and if it does not impede or obstruct others to do the same by assuming that everyone does the same in the same situation.<sup>161</sup> The action of gifting objects of life, to later on have them “killed” and reuse the materials for the sake of all the reasons mentioned along the paper for the introduction of circular economy models is consistent with this principle. On the one hand, the reasons for them are consistent and coherent because everyone can do it if they have the same reasons, and in fact we all do. On the other hand, generalizing this concept to everyone does not impede or obstruct others from acting the same way. On the contrary, it encourages others to do the same and compounds the results of these actions. Therefore, there is reason to implement this idea as a moral imperative, satisfying deontological ethicists.

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<sup>160</sup> Larry Alexander and Michael Moore, “Deontological Ethics,” in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta, Winter 2021 (Metaphysics Research Lab, Stanford University, 2021), sec. 2, <https://plato.stanford.edu/archives/win2021/entries/ethics-deontological/>.

<sup>161</sup> *Rational Choice Part I*, 2012, <https://www.youtube.com/watch?v=nuDLPu85YQY>.

However, there is the chance that someone uses these rules to hijack the logic of circular economy and maintain objects of sentimental value for too long, attributing life to them but not death. This sort of artificial immortality coming from artificial life in the first place must be prevented because it is key to the producers that the materials are guaranteed to reinsert the cycle for them to fully adopt circular economy models. This means that there must be very specific rules that explain in which instance a product is considered of sentimental value. For example, only products that belonged to people that are now dead and are relatives to us can hold sentimental value, and even then, only a certain number of products can be kept from this person. This would mean that those who wish to keep objects of sentimental value for longer must proof their relation to the dead person in question, and they would have to select what truly is meaningful to them. Whichever criteria is used to determine the differences in sentimental value of the objects and the time extension that people get to mourn their loved ones through them, it is important that it is clear and does not leave a shadow of ambiguity that people can exploit, despite the fact that in circular economic models retaining the materials or broken products is counterproductive to the individual consumer.

Regarding the other major group of ethicists, the virtue ethicists whose ideas are to some extent derived from Aristotle's *Nicomachean Ethics*, they believe that actions are ethical or not depending on if they act in accordance with virtues, or if they compromise them instead. These virtues are supposed to be common ground, or general ideas on who we are as human beings. I believe that the proposal of giving life to objects to "kill" them and reintroduce their materials into the cycle is in accordance with certain values that can be considered virtues. Some that can come to mind are restoration, harmony, preservation

as the mean between, for lack of better words, archaicism as in preserving things too far and disrupting progress, and ultra progressivism as in striving for progress regardless of its long-term sustainability. It can be argued that the act of taking something's life, even if it is an object, is a vice that compromises certain virtues such as the respect for life, or maybe the idea that we are playing to be God by deciding what gets to have life and what does not get to have life. In practicality, Hooker argues that it is irrational to sacrifice a virtue except for the sake of another one.<sup>162</sup> Therefore, in the event of these compromises of virtues, it is still arguably ethical to act this way regardless because other virtues are being upheld in the same action.

As per the special case of art and the Great Books and Texts, I would say that those items are not actually of sentimental value, as can be initially thought of. The ideas they have are of essential importance to define and justify what we know and what we are, therefore making them intrinsically utilitarian at their core. Since they are a testament of this knowledge, for as long as they exist, they can be considered alive in the sense that they provide a form of value to the world.

This recommendation can seem strange and very far from our current cultural conventions. However, at its core it is not something that is ethically entirely against what we value of ethics. It maintains respect for life, and I believe by addressing it to all products and materials we do not make life something common and banal because it is still respectful of it, and even protects it. On top of that, it is a practice that is necessary if we want a sustainable future, therefore even in the event that this is disruptive of ethical

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<sup>162</sup> *Rational Choice Part II*, 2012, <https://www.youtube.com/watch?v=UHcMnSnH5iA>.



perspectives, we may just have to either bite the bullet or rewrite our ethics so that we do not have to put them against environmentalism.

## Conclusion

Rebuilding the entire economic model that we operate upon is no easy task, neither in theoretical terms nor in practicality. Many areas must be addressed to shape the economic model that we want, from environmentalism to ethics and politics, because at the end of the day economics is a field that is meant to work for us, not the other way around as we sometimes tend to think. That is the reason why, for example, countries have a minimum wage even though it is counterproductive economically, or why sometimes the government intervenes in the pricing of certain products. Not having them could be favorable economically, but at the expense of the people that it is supposed to serve.

The difficulty of the task at hand, however, should not be a deterrent in striving to find the optimal settings for an economic system. The rewards are ultimately what allows for society to progress. Optimal economic systems allow for a business environment that encourages innovation and improves living standards because of it. Environmentalism has stopped being a minor factor, or even non-factor. The urgency of solving or mitigating at least the effects of climate change has made environmentalism a dominant factor in how we need to shape our economy in the coming years. Circular economy provides a feasible solution to the issue of climate change, while also addressing other pressing topics such as the scarcity of rare materials, therefore making it a strong candidate for long-term sustainable models that can be upheld in the future.

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