

The Transition in Economic Theory from Linear to Circular for the Sustainability: A Case Study

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Abstract

The ability of our society to endure and expand while preserving enough natural resources for future generations to live is known as sustainability. Sustainable development, which combines structures, procedures, and local, national, and international support, supports its long-term goal. It is the high time, when the world is looking for the environmental conservation, conservation of the planet's biodiversity, social progress and better life style for the environment means a transition for the sustainability. The economy needs to undergo a profound transition because it was built on the principles of "take, make, consume, and discard" and the so-called "linear model," which was based on the idea that resources were infinite and easily accessible from the start of capital accumulation and the industrial revolution. According to this study, a product's value can only be increased by staying within the circularity loop, which means moving from the current linear model paradigm to a circular model. Study also reveals that the businesses and production units that want to generate a competitive edge while using fewer resources need to redesign and restructure their current processes. And it is highly required that the very last resort should be resource disposal and incineration. It is therefore highlighted that the program for the usage of material resources in respect to the global 2030 plan will not be implemented effectively unless the concept of a "circular economy" is adopted in place of the "linear economy." The author of this article examines how the "linear" to "circular" economy changes using a few chosen cases, offering a comprehensive grasp of the topic and the mechanisms of global transformation.

Keywords: Linear Economy, Waste, Circular Economy, Sustainability.

1. INTRODUCTION

Sustainability is 'meeting the needs of the present without compromising the needs of the future' and 'ensuring a balance between economic growth, environmental protection, and social well-being (UN, sustainability, 1987).' In addition to ensuring the long-term preservation of the environment and its natural resources, the 2030 Agenda for Sustainable Development and its global goals seek to eliminate poverty and hunger, realize everyone's rights, and achieve gender equality and the empowerment of all women and girls. "To achieve sustainability and sustainability goals, some of the initiatives are: infrastructure imperatives, carbon management, green energy, circular economy, environment conservation, water conservation and energy efficiency (TUV-SUD, 2023)." Out of these seven initiatives 'economy, environment and society' are three entangled pillars of sustainability. And the sociocultural aspect focuses on stakeholder and employee interactions, the economic factor on the organization's bottom line, and the environmental factor on ethical business practices. Since, "society

has traditionally welcomed productivity since it helps both producers and consumers through economies of scale and consumer surplus (Brian, Neva, & Julie, 2019).” However, the question remains: is this the best illustration of resource sustainability—where equilibrium is reached between the factors of production and its proportionate utility, implying the unquestionable preservation of resources for future generations—or is this the golden rule of production and consumption? “The clandestine decay of resources that is jeopardizing the eco- system is in process. Every segment of an economy including service, manufacturing and agriculture is epitomizing productivity to satiate their voracious quench for remaining competitive (Sandoval, Garcia, & Goenaga, 2016).” However, they are incapable of bringing the opulence of sustainability to life. Progress in society is not the issue, but with the methodology, this has a devastating and harmful effect on the environment. “The concept of the circular economy does not ignore global development needs, but it differs from traditional models by closing the industrial loops through ecologically effective eco-innovations (Vanessa, Carmen, & Marta, 2016).” In the global production scenario, natural material resources are employed, among other things, to make goods and render services. The underutilization of such material resources is partly caused by the development of technologies and the prevailing value systems. “The contemporary model of economical production and consumption is not sustainable; if the pattern continues, humankind will need to scramble for resources. Currently, resource extraction from the earth is 1.7 times higher than her actual capacity (Jonathan, 2018).” This is essential element that the economy and the environment may benefit from better use of these resources or more efficient waste management, when there is a strong demand for limited material resources. In the market of liberal competitiveness, better management of these resources could be a distinct advantage.

Today's "take, make, and waste" or 'linear economy' has significant and far-reaching effects on the environment. The route of transition from 'linear' to 'circular' economy is difficult since certain presumptions must be true, they are: established awareness, constituted institutional structure, developed infrastructure for waste management, expertise and knowledge, the supply of necessary resources, tenacity, scientific approach, and a fresh outlook on the future and economic representativeness. “Resource extraction has more than tripled since 1970, including a fivefold increase in the use of non-metallic minerals and a 45% increase in fossil fuel use by 2060, global material use could double to 190 billion tonnes (from 92 billion), while greenhouse gas emissions could increase by 43% (UNEP, Global Resources Outlook 2019, 2019).”

“According to the Circularity Gap Report 2023, the global economy is now only 7.2% circular. The global situation is getting worse year on year—driven by rising material extraction and use. Rising material extraction has shrunk global circularity: from 9.1% in 2018, to 8.6% 2020, and now 7.2% in 2023.” “This leaves a huge Circularity Gap: the globe almost exclusively relies on new (virgin) materials (Circle_Economy_Foundation, 2023).” It implies that more than 90% of materials are either thrown away or remain unusable for years because they are limited to stable assets like buildings and machines. “The combustion of fossil fuels, that have driven this growth, has already contributed to a 1.1°C average global temperature increase, and could lead to a 3.5°C increase by 2100 without global action (UCAR, 2023).” “Many of the impacts of climate change, such as more frequent and intense storms and floods, lengthier droughts, sea level rise, increased number of extreme heat events, changing freeze patterns, and more frequent and intense forest fires are already being felt in countries and regions such as Germany and China, the Arctic and Australia, USA and Turkey (IPCC, 2021).”

“As per a report published by the United Nations, primary resource extraction which was comprised of

roughly 22 billion tons in 1970, included materials such as fossil fuel, metals, and timbers. This ballooned to roughly 70 billion tons in 2010. If the rate continues in this pattern there will be 180 billion tons of material needed annually by the year 2050 (Dominique, 2016).” “Regrettably, the oscillation is coming back to us, the tiny particles from cars, power plants, waste incineration, and other sources are killing over 9 million people worldwide each year and the estimated annual global health cost due to air pollution is currently over \$15 trillion (CBS_NEWS, 2022).” “Based on the simple concepts of reducing waste, reusing materials and redesigning how we create value from products and services, the idea of the circular economy have emerged as a beacon for moving away from a take-make-dispose culture and society. It also presents the opportunity to fundamentally address how we create value in our economies and minimize the liabilities that they create hallmarks of a green and inclusive economy (Stevan, 2017).” We need to better match our economies with this reality since, as noble thinkers pointed out some years ago; we are on a ‘spaceship earth.’ Controlling and making use of an apparently endless resource frontier has been the cornerstone of our traditional approach to progress and wealth. Due to this, the concept of a ‘cowboy economy’ has emerged, where everything is possible and money is available to anyone. “As stated in the UN Environment report of 2010, North America and Europe had an annual per capital material footprint of 25 and 20 tons, whereas it is 9 for Asia Pacific (Dominique, 2016).” It is also evident that, up until 2022, the unequal allocation of resources around the world has led to the ‘dumping economy,’ which has intensified international trade disputes.

2. LITERATURE REVIEW

The shift to a circular economy necessitates methods that could result in lower rates of resource extraction and consumption. As a result, sustainable materials management is promoted and resource efficiency is increased. Here, economic growth is the term used to describe increased output of goods and services. “Economic growth can be influenced by changes in capital goods, labor force, technology, and human capital. Economic growth is frequently assessed using figures like the GDP in terms of the rise in the total market value of newly created products and services (Investopedia, 2022).” The earth as a source of food and non-renewable material resources, the environment's ability to absorb waste and various emissions as a negative environmental aspect of production processes, and the consumerism-driven urban lifestyle are at least three major trends that present limits to growth. Disregarding these restrictions puts long-term human life on Earth at peril. It leads to a number of immediate political, environmental, and economic issues. “The effects of climate change on various societal segments are interconnected. Food production and human health can be harmed by drought. Flooding has the potential to spread illness and harm infrastructure and ecosystems (National_Geographic, 2019).” Health issues can affect food supply, increase mortality, and lower labor productivity. The effects of climate change are evident in every facet of our global community. Nonetheless, the effects of climate change are not uniform throughout the nation and the world; they can vary even amongst communities, neighborhoods, and people (NOAA, 2021). There are additional effects of several aspects of the linear economy. “The global food system contributes around 70 per cent of biodiversity loss and also consumes 70% of available freshwater (FAO_UN, 2017).” “The linear economy also drives huge quantities of waste with around 24 billion tons per year being discarded, much in uncontrolled landfills. A rapid shift to a more Circular Economy, which drives reduced use of raw materials, redesign, reuse, repair, remanufacture and recycling at every step of the value chain, could dramatically cut resource use, and coupled with decarbonization, can deliver a low carbon and lo-

wer impact future (Richard, 2021).”

It needs to be noted that five major shifts are driving the transition from a linear to a circular economy: first, the worldwide regulatory environment; second, shareholder demands; third, the need for increased supply chain and business resilience; fourth, shifting consumer preferences; and fifth, the COVID-19 global pandemic's effects. By adopting a more circular strategy, businesses have a genuine chance to cut expenses, strengthen the robustness of their supply chains, adhere to new regulations, and satisfy investor and customer demands. “To do this, companies and business can prioritize where they can take action to have the most impact on greenhouse gas emissions and conduct ‘transformational sprints’ (frontiers, 2022) to use of a value-chain approach to circularity.” Businesses must shift these value chains, which are made up of all the processes that add value to or take value away from products, including developing, manufacturing, distributing, selling, and consuming them.

2.1. The idea behind linear economy

“A linear economy is a strategy that emphasizes the ‘take’, ‘make’, and ‘dispose’ maxim, and it is a system where resources are extracted to make products that eventually end up as waste and are thrown away (Paul, Teresa, Paul, & Raimund, 2019).” The earth's resources are taken out, and then goods are made for consumption. After this consumption, the leftovers either build up in a landfill or are burned. For this reason, the take-make-waste economy is another name for the linear economy. As the term implies, goods and materials in a linear economy always flow from raw material to trash and are typically not exploited to the fullest extent possible. This linear economy was made possible by the industrial revolution, which has produced numerous advantages. Mass production of things was possible for the first time (Ellen-MacArthur-Foundation, 2018). “Plastic is just one example of the detrimental external effects that we are dealing with due to linearity. There are countless such offenders, including steel, aluminum, paper, cans, leather, oils, and fossil fuels. Unspeakably, only 14% of plastic is recycled annually, and if this continues, by 2050, there will be more plastic than fish in the oceans (Mary, 2017).” “Worldwide use of plastic has increased 20-fold in the past 50 years, and it is expected to double again in the next 20 years. More than three times as much plastic will be produced by 2050 as compared to 2014. Once plastic gets into the waterways; it brings \$13 billion in annual losses to tourism, shipping, and the fishing industries (Sarah, 2016).”

However, excessive corporate competition has reduced the lifespan of products, made them obsolete, and converted them into waste, disrupting the environment's equilibrium balance. Figure 1, which is illustrated below, shows how resources move in a linear economy where they are eventually thrown away in landfills.

Figure 1: Phases of the linear economy model



The idea of a linear economy served as the growth paradigm, while raw resources were easily accessible and inexpensive, and technology were enhanced and optimized. “Production, employment, profit, level of life, urbanization, and demand for a wide range of goods all increased as a result of this rise (Sónia & António Cardoso, 2022).” In actuality, it's a vicious circle, the motion of which was frequently impacted by the crises of hyper production. The idea of a linear economy is characterized by the environmental disposal of trash that results from the industrial process.

2.2 Waste

Waste is defined as an item or substance that is no longer fit for its intended use. Trash from human activity is usually used as food or a reactant (e.g., oxygen, carbon dioxide, and dead organic matter), but it is sometimes quite robust and takes a very long time to breakdown in natural ecosystems. “Article 5 of the Basel Convention: ‘Wastes’ are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law’ (UN, 1989).”

According to OECD –“Wastes are substances or objects, other than radioactive materials covered by other international agreements, which: i) are disposed of or are being recovered; or ii) are intended to be disposed of or recovered; or iii) are required, by the provisions of national law, to be disposed of or recovered. Waste is generated at all stages of human activities: during the extraction of raw materials, the processing of raw materials into intermediate and final products & the consumption of final products (OECD-iLibrary, 2020).”

2.3 Global waste generation

“Global waste is expected to grow to 3.40 billion tonnes by 2050. The world generates 2.01 billion tonnes of municipal solid waste annually, with at least 33% of that extremely conservatively not managed in an environmentally safe manner (Statista, 2023).” “According to the World Bank on waste management, worldwide, waste generated per person per day averages 0.74 kilogram but ranges widely, from 0.11 to 4.54 kilograms. Though they only account for 16% of the world’s population, high-income countries generate about 34%, or 683 million tonnes, of the world’s waste. The total quantity of waste generated in low-income countries is expected to increase by more than three times by 2050. The East Asia and Pacific region is generating most of the world’s waste, at 23%, and the Middle East and North Africa region is producing the least in absolute terms, at 6%. However, the fastest growing regions are Sub-Saharan Africa, South Asia, and the Middle East and North Africa, where, by 2050, total waste generation is expected to more than triple, double, and double respectively (World-Bank, 2023).”

Figure 2: Projected waste generation, by region (millions of tonnes/year)

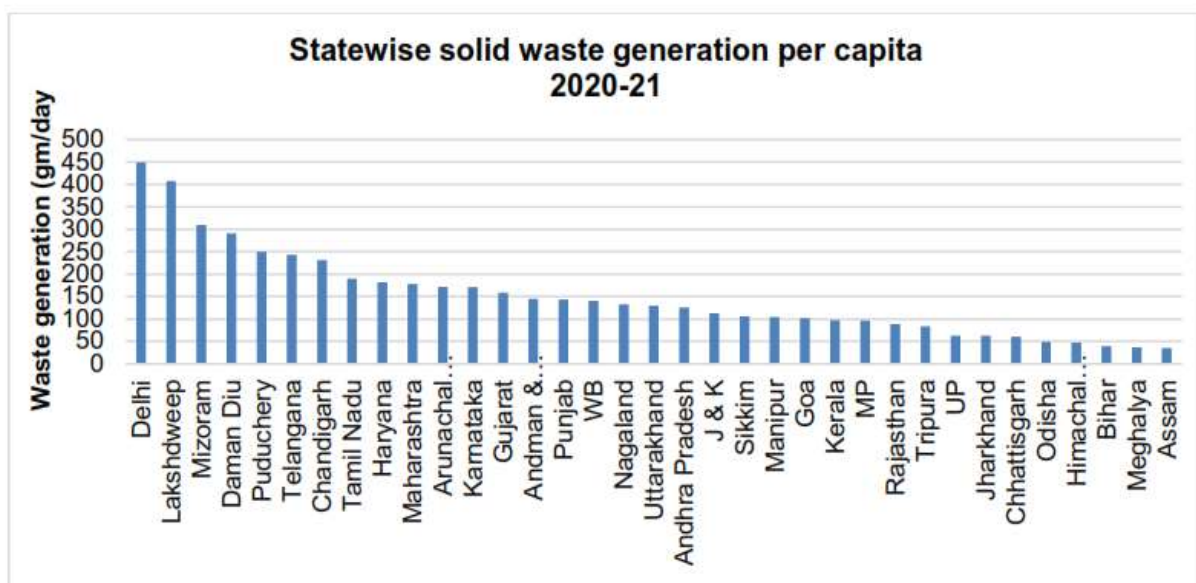


(Internet Source: World Bank on “WHAT A WASTE 2.0; Trends in Solid Waste Management, 2023”)

2.4 Waste generation in India

“The total quantity of solid waste generated in the country is 160038.9 TPD of which 152749.5 TPD of waste is collected at a collection efficiency of 95.4%. 79956.3 TPD (50%) of waste is treated and 29427.2 (18.4%) TPD is landfilled. 50655.4 TPD which is 31.7% of the total waste generated remains un-accounted. Per capita Solid waste generation in the 2018-19 was 121.54 gm/day, in the year 2019-20 it decreased to 119.26 gm/day, subsequently in the year 2020-21 it remain 119.07 gm/day (CPCB, 2021).” Per capita generation of solid waste in different States/UTs is illustrated in Figure 3.

Figure 3: State wise per capita solid waste generation in India



[Source: “Annual Report 2020-21 on Implementation of Solid Waste Management Rules, 2016”, Page 7, Central Pollution Control Board, MoEF&CC, Govt. of India, New Delhi]

It has been noted that Delhi generates the most solid waste per person, followed by Lakshadweep and Mizoram, in that order.

Dominance of the linear economy paradigm is the cause of the comparatively poor state of waste management in the examined countries. This circumstance does, however, also offer a significant opportunity to abandon the linear economy idea. Earth's resources are limited and finite. Because of the trends toward global population growth and industrial expansion, which result in an ever-increasing demand for natural resources, an endless growth is therefore not feasible. Therefore, it can be said that there is a growing worldwide awareness of the need for transition and the rejection of the liberal economy model.

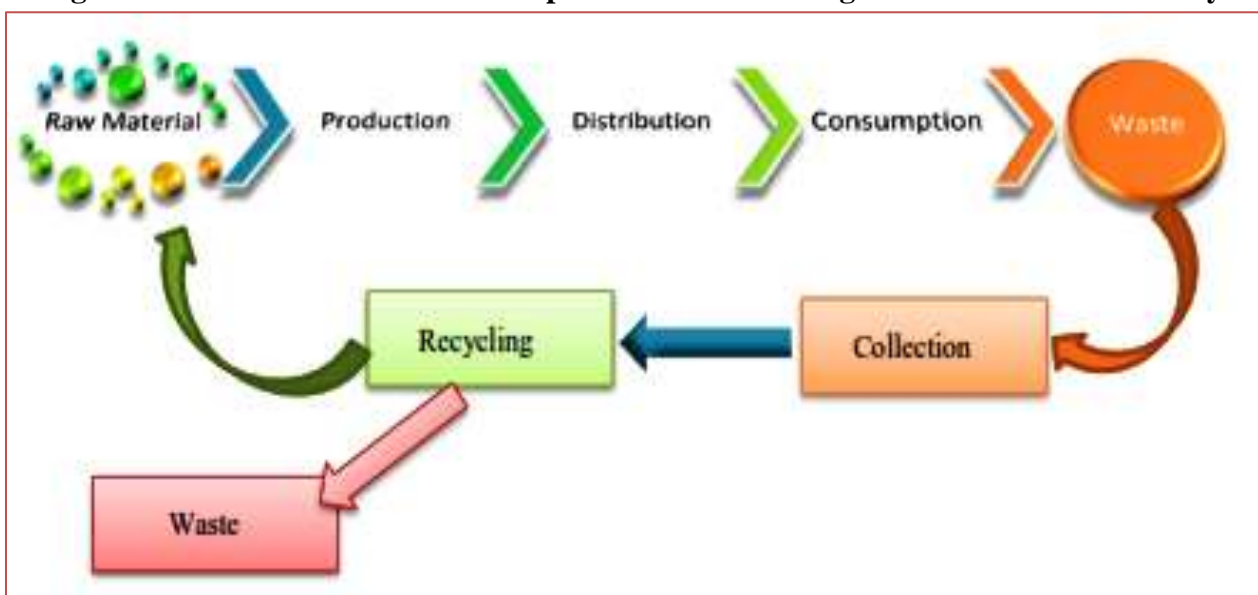
2.4 The circular economy concept

“The circular economy is a framework for systems solutions that addresses global issues such as pollution, waste, biodiversity loss, and climate change (Kweku, Lalen, & Henrique, 2022).” These goals have their foundation on 3 ‘design-driven principles’ which aims to reduce waste and pollution, recycle

materials and products as much as feasible, and restore ecological damage. A circular economy not only causes a change in public policy and taxation but also has significant effects on production, employment, education, money, and finance. This paradigm prioritizes the production of radical resources, eliminates waste, makes ownership accessible, and presents an opportunity to restore resilience and natural capital, all of which have positive economic effects (Ellen_mac_arthur_foundation, The Circular Economy: A Wealth of Flows, 2015).

A well-known fact is our planet's resources are finite. Because of this, we are dedicated to making the circular economy a viable, forward-thinking idea in the sector and to using it to preserve the environment. “The circular economy is oriented to nature as its role model. In essence, the concept of the circular economy aims to keep raw materials in a closed loop. In this way, resources are maximally used, the need for new ones is reduced, waste is avoided and the life cycle of products is increased. In short, the waste of today becomes the raw material of tomorrow - the same as in nature (Lenzing, 2023).” In this sense, the linear economic system that now governs the production, consumption, and disposal of goods is different from the circular economy. The circular economy advocates for a shift from the traditional extract-produce-dispose economic model to a restorative and regenerative approach that emphasizes extending the life cycle of a product in order to maximize value extraction. The circular economy eventually closes the loop in the industrial environment and lowers waste by repurposing products that have reached the end of their life cycles. Remanufacturing, recycling, repair, and reuse are among its basic principles. The resource flow in the circular model of production and consumption is depicted in Figure 2. To get the resources to transmit back into the production loop, maximum prioritization is applied. Means, reuse, recycling, refurbishing, and remanufacturing are prioritized over disposal.

Figure 2: Feedback Circles an assumption for transforming linear to circular economy



2.5 The circular economy's guiding principles

‘Driven by design’, the circular economy is founded on three principles:

- “The first principle of the circular economy is to eliminate waste and pollution. Currently, our economy works in a take-make-waste system. We take raw materials from the Earth, we make

products from them, and eventually we throw them away as waste. Much of this waste ends up in landfills or incinerators and is lost. This system cannot work in the long term because the resources on our planet are finite. Eliminating waste and pollution is not limited to packaging. Textile Company ‘DyeCoo’ has developed a technology for dyeing textiles without using water and therefore eliminates toxic waste water (DyeCoo, 2020). Instead of water, ‘DyeCoo’ uses carbon dioxide as a solvent in a closed-loop system. While the capital investment in the equipment is higher than for conventional dyeing, the company reports it can reduce operating costs due to the short batch cycles, the efficient dye use, and the avoidance of wastewater treatments. The technology can also reduce health and safety risks by minimizing worker exposure to toxic chemicals (Ellen_mac_arthur_foundation, 2020).”

- “The second principle of the circular economy is to circulate products and materials at their highest value. This means keeping materials in use, either as a product or, when that can no longer be used, as components or raw materials. This way, nothing becomes waste and the intrinsic value of products and materials are retained There are many innovative companies already designing their products with recirculation in mind. ‘Evocative’ makes compostable packaging from agricultural byproducts (the parts of crops that cannot be eaten) and mycelium (mushroom roots). The packaging works like expanded polystyrene to protect fragile items in transit, but it is from a renewable source and does not contribute to plastic waste. Mycelium is a fungal network of threadlike cells that acts like natural, self-assembling glue (Wikipedia, 2017). It grows in 5-7 days without needing any light or water, digesting agricultural by-products and binding into any shape needed. At the end of the process, the material goes through a dehydration and heat treating process to stop the growth and to ensure the absence of spores or allergens. Once used, it can be safely composted and returned to the soil (Ellen_mac_arthur_foundation, Circulate-products-and-materials, 2017)”
- “The third principle of the circular economy is to regenerate nature. By moving from a take-make-waste linear economy to a circular economy, we support natural processes and leave more room for nature to thrive Connect the Dots is a city-led initiative to promote local regenerative agriculture in the rural zone of the state of São Paulo, protecting natural systems threatened by urban sprawl and conventional agricultural practices. The municipality purchases produce from local farmers to provide healthy food for vulnerable people. It does so at 30% more than market value to incentivize the transition to regenerative practices and promote social inclusion (Ellenma_carthur_foundation, 2017)”

2.6. Comparing the Linear and Circular Economies

The methodology and approach, the adopted business model, the viewpoint on sustainability, and the way value is created or maintained are the primary distinctions between the linear and circular economies. Comparative analysis has been shown in table 1.

Table 1: comparing Linear Economy with the Circular Economy

Parameters	Linear Economy	Circular Economy
Methodology	In a linear economy, the "take-make-waste" process is followed.	The circular economy eliminates waste entirely by adopting the 3R strategy of "reduce, reuse, and recycle."
Visualization	The conventional linear model creates	In contrast, the circular method considers

	value through mass production and sales, concentrating solely on profitability and short-term revenue.	sustainability and has a long-term perspective and it is for the whole life cycle of a product. Longer life cycles can be achieved through product regeneration, repair, and update.
Viewpoint on Sustainability	The linear economy strives for eco-efficiency when it comes to sustainability, attempting to accomplish the same goal with less of an adverse effect on the environment. By repurposing materials to create a lower-value product, This only inhibits circularity and slows down the linear flow of resources from production to trash.	On the other hand, the circular economy aims to make products more environmentally friendly. This eliminates all environmental damage, and it may even have a positive effect. It excludes the concept of waste and turns raw materials into something far more valuable than it was before.
Business model	The products that are produced, used, and then discarded as waste are the main focus of the current linear economic model.	Rather than focusing on producing a single product that can be replicated for numerous users, the circular model offers a single service that can be utilized by many.

[Source: CONTEC S.A. | Al. Jerozolimskie 142a, 02-305, Warsaw, Poland (Contech, 2022)]

3. METHODOLOGY

This study falls into the category of basic research. The development of knowledge, theories, and predictions is the goal of this research project. Primary and secondary sources additionally supplied data for the purpose of this research. Primary data is directly gathered by the researcher. Since secondary data has already been gathered by another party, the literature review has been created using information from books, journals, periodicals, websites, reports from academic and research institutions, and documents from the internet. By documenting the changes that have taken place throughout time that is, the transition from a linear to a circular model. This study seeks to improve understanding of the existing situation of the economic domain. For this study, data is gathered through longitudinal research, which is a study that has been conducted to compile data over an extended period of time. Making choices from all of these various research kinds is a step in the process of developing this research design.

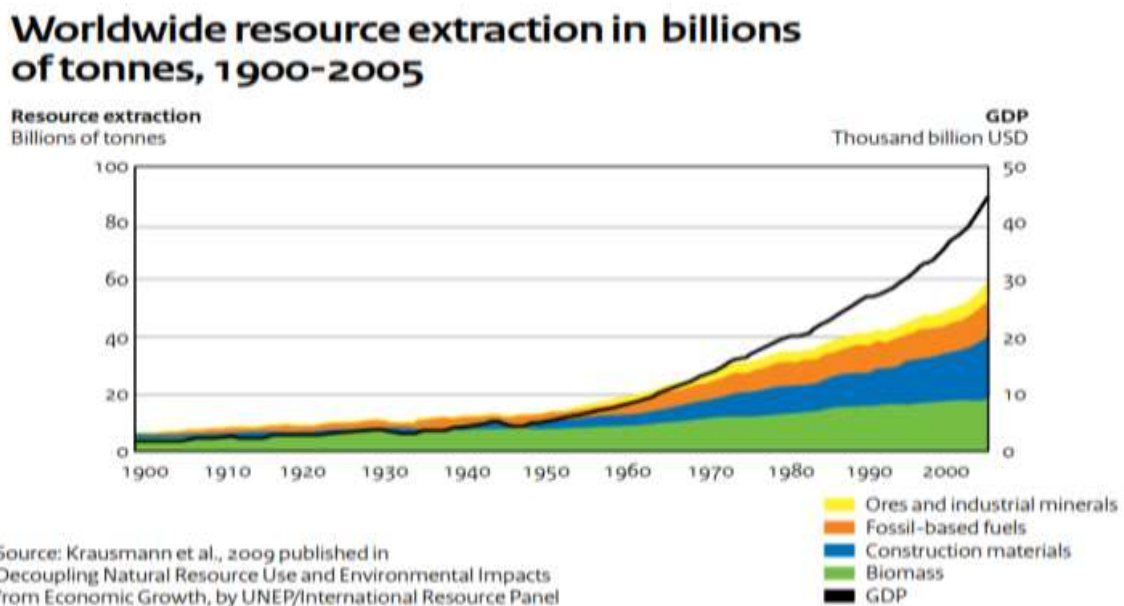
4. EMERGENCE OF CIRCULAR ECONOMY

Waste management is typically the initial thought, that enters when someone refers the circular economy, but there are many other applications as well. We are surrounded by approaches to the circular economy. They can be used in many different industries, such as textiles, construction, and building, and at various phases of a product's lifecycle, including design, production, distribution, and disposal. Let's examine the emerging market for the fashion, apparel, textile, building construction, and electronic businesses. "In textile and fashion, there are initiatives that employ regenerative agriculture to produce organic cotton and other natural fibres, using natural colorings and dye, thus ensuring higher quality and safer garments for the health of consumers and the environment. By producing higher quality garments,

clothing can also last longer, be repaired, thrifted, and recycled. Similarly, in buildings and construction, circular solutions can include reducing virgin material use, re-using existing materials in circulation, or substituting carbon-intensive materials for regenerative alternatives such as timber. Meanwhile in a circular economy, electronic goods are refurbished, water-soluble, recyclable and truly biodegradable packaging becomes the norm, and animal waste is used as natural fertilizers and processed into biogas for cooking, heating and lighting (UNDP, 2023).” UNEP in its report –“International Resource Panel, Decoupling Natural Resource Use and Environmental Impacts from Economic Growth, 2011 (UNEP, Decoupling Natural Resource Use and Environmental Impacts from Economic Growth, 2011) states that- by 2050, humanity could devour an estimated 140 billion tons of minerals, ores, fossil fuels and biomass per year three times its current appetite unless the economic growth rate is decoupled from the rate of natural resource consumption. Developed countries citizens consume an average of 16 tons of those four key resources per capita. By comparison, the average person in India today consumes four tons per year.”

The developments listed above necessitate a more efficient use of raw materials and substitution with readily available, sustainable, renewable raw resources. Since humanity has already far outpaced the earth's capacity in using natural capital, social and environmental consequences will be severe even if the economy reacts to a shortage of resources (Samantha, Nepomuk, & Olga, 2022). A study based on the decoupling of the natural resource use has shown the worldwide resource extraction as shown in figure 5. As per the study four primary raw material categories are extracted: biomass, ores and industrial minerals, fossil fuels, and construction minerals. Together, these categories are estimated to be harvested at a rate of 47 to 59 billion metric tons (47–59 Gt) annually (2005 data), with a clear trend toward continued increases in the future (Figure 5).

Figure 5: Worldwide resource extraction



[Internet Source: Report on “Decoupling Natural Resource Use and Environment Impact from Economic Growth, UNEP International Resource Panel”, United Nations Environment Programme]

Most of these resource categories have shown a consistent decrease in price, which has either prompted or accompanied the constant rise in these raw materials' consumption. Although declining prices could be seen as a sign of an increase in supply, they are more likely to be the result of more effective extraction techniques and structurally precarious market positions for some developing nations that export abundant natural resources. However, the cost of extracting many essential resources is rising; “petroleum in the Arctic and open waters are two prime examples. The price volatility of at least some of these resources has increased recently, suggesting that a faster transition based on the decoupling of growth rates from rates of resource use and adverse environmental impacts may be possible (Fischer-Kowalski M. , et al., 2011).”

4.1 India's circular economy

During its G-20 presidency, India has adopted four key areas for the circular economy: circularity in the steel industry; Extended Producer Responsibility (EPR); circular bio economy; and creating an industry coalition for resource efficiency and circular economy led by the industry (Drisht_Foundation, 2023) . “The goal of the circular economy is to remove all types of ‘waste’ or ‘junk’ from the market, where ‘junk’ is defined as any ineffective use of resources or assets (FICCI, 2022).” Reducing environmental consequences through product and material redesign, recovery, and reuse is the essence of this restorative approach to production and consumption. India's economy is predicted to be the third largest in the world by 2030, making up around 8.5% of the world's GDP. Apart from providing significant environmental benefits, the circular economy can facilitate India's development and establish a sturdy and enduring structure (TWN_solutions, 2023). “The National Chemical Laboratory (NCL) and PET Packaging Association for Clean Environment have estimated the value of the recycled Polyethylene Terephthalate (PET) plastic business in India to be between US\$ 400 and 550 million. PET is recycled 90% of the time in India compared to 72% in Japan, 48% in Europe, and 31% in the US. India thus offers a plethora of options for a circular economy (Hindustan_Times, 2017).” To justify the research, we will go through the case studies across the globe starting with the Indian region.

India's rapidly evolving market and vast development potential may provide it a competitive advantage over more established countries. The ambitious long-term vision of a circular economy has the potential to promote resilient and sustainable prosperity, given the current capabilities of the Indian market and the integration of numerous stakeholders. “Innovations in the circular economy will not only strengthen the resilience of the agricultural and urban economies, but they will also yield advantages like reduced greenhouse gas emissions, increased biodiversity, food and water security, job creation, and the empowerment of marginalized communities (Joseph, Praveena, & Kavya, 2020).” The development of a comprehensive and rigorous roadmap is necessary for the adoption of a circular economy. The net-zero future will affect every aspect of our daily life since it is such an imperative. As a result, start-ups that deal with waste management throughout the design phase will have a multitude of options to help close the loop and make the world a more sustainable place. Plant-based proteins, carbon emission monitors, electric cars, and innovative battery technology are a few examples of these prospects.

4.2 Case1: Eco-friendly packaging of India's TATA Salt Brand

Tata Chemicals' consumer products segment requires 4,000 tonnes of multi-layer plastic film annually to package its products (TATA, 2023). India Brand Equity Foundation conducted an investigation into packaging materials that could be biodegradable and recyclable as part of its sustainability program.

Owing to its difficulty in recycling, the majority of this multilayer plastic is disposed of in landfills, which releases emissions and negatively affects the environment. “The packaging team then worked closely with Dow Chemicals to create a PE (polyethylene) based film that could match the PET used in the current packs in terms of print quality and other technical requirements. The newly designed recyclable pack is an adhesive laminate with a similar shelf life and appearance to the previous packs. It is constructed of the same polymer (PE-PE) (IBEF, 2023).” This method is not commercially feasible due to issues such as the scarcity of packaging materials that are 100% biodegradable, the need for appropriate segregation, and the need for precise conditions for the material to break down. As a single polymer constitutes the laminate, recycling groups are effectively building it. The single polymer structure of the pack therefore makes it more easily recyclable because it may be transformed into energy through a range of processes like combustion, gasification, pyrolysis, anaerobic digestion, and landfill gas recovery (Wanda, Marta, Barbara, & Joanna, 2021) .

5. TRANSITION FROM LINEAR CONCEPT TO CIRCULAR ECONOMY

“The term transition refers to practices used by states and peoples to attempt to attain economic growth and development as well as social welfare levels comparable to those of the developed world, primarily those of North America and West Europe (ScienceDirect, 2022).” The idea of the linear economy is abandoned in the process of transition, which is viewed as an improvement process. It does not find a new home until the most recent significant changes in the economy, environment, and climate occurred in 2008. At that point, a new perspective on the so-called circular economy begins to surface. The circular economy calls for a revised understanding of social responsibility, which includes sustainable development, rather than serving as the only solution to the economic crisis. While the phrase is typically associated with developing nations attempting to achieve the aforementioned objective, the phenomena of transition need not be limited to the developing world. Specifically, wealthy states also work hard in order to establish the ideal conditions for new, quicker social and economic growth, which will raise their residents' standard of living and improve their quality of life overall. It is noteworthy that some nations declined to implement the shift in accordance with stringent neoliberal policies. This led to some fascinating results and offered an alternative that served as a foundation for additional study and reassessment of neoliberal economic theories. The transition from a linear economy to a circular model could motivate companies to engage these new markets in an effort to increase their market share. Additional strategies to maximize a product's value include keeping it in the circular loop and extending its life cycle through reuse, refurbishing, or remanufacturing (Zacharaki, Thanasis, Nikolaos, Aikaterini, & Yuchun, 2021).

5.1 Case 2: Netherlands' Action Plan for the Circular Economy

The circular economy offers a solution to the 21st century's biggest problem, which is making considerably better use of raw materials. Government of Netherlands in its planning assumes that- “A major shift in the way we use raw materials is required if we are to keep feeding humanity, supply it with the necessities, and ensure that people have a decent life.” Government of Netherlands trusts that “an economy that provides for people’s needs without placing an unacceptable burden on the environment and without exhausting natural resources.” It will be necessary to implement adjustments in a broad sense to meet this issue.

It implies that the innovations in systems, society, and technology will need to be put into practice. This is the transition that presents economic opportunities to the Netherlands. It has helped to create a cleaner environment and lessen the nation's reliance on the import of rare raw materials. Now the country practices a circular economy, which treats goods, materials, and resources within the limits of the earth's capacity and in an efficient, socially conscious manner, ensuring that future generations continue to enjoy material prosperity. “The national laws and regulations of the Netherlands states that – a climate-resilient economy is a circular economy. Waste is the new raw material in a circular economy. The life of a product is no longer just about producing it, using it, and then throwing it away. In addition to saving raw materials and the environment, this lowers CO₂ emissions. It promotes employment, new business ventures, and innovation (Government_of_the_Netherlands, 2023).”

As of right now, the nation views the circular economy as its natural environment. For instance, the government has previously taken action to stop littering in public areas and on streets. Another instance is free plastic bags are no longer allowed in the country. “Almost 80% of customers state they frequently or always bring their own bags rather than purchasing single-use plastic bags from the store. The philosophically they believe that – consumer behavior needs to change for a circular economy”. It implies that other elements are also required for a circular economy to be successful, in addition to business and the government. Customers need to take responsibility for this as well; buying sustainable goods needs to become the new standard. By mending, consigning, or prolonging the life of things, consumers can further advance the circular economy. The government intends to promote this kind of behavior through public awareness campaigns and the inclusion of the circular economy into educational curriculum.

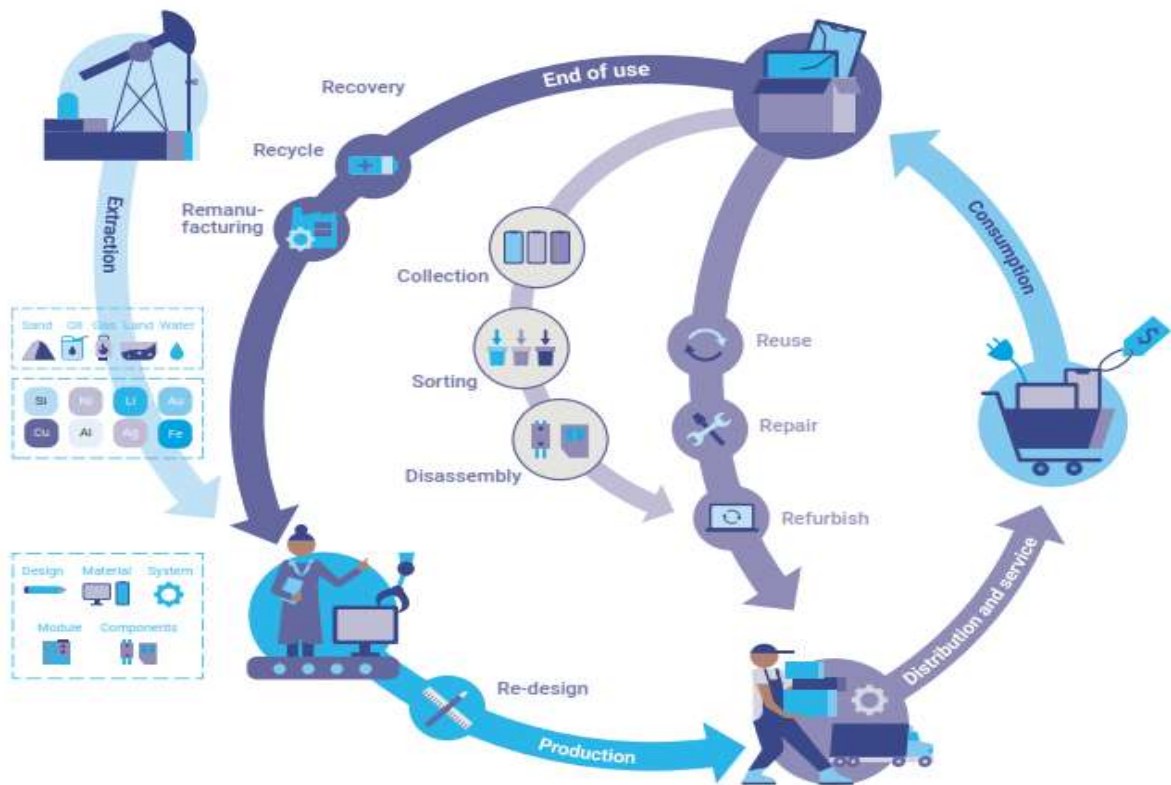
6. TRANSFORMING LINEAR TO CIRCULAR ECONOMIES IN BUSINESS.

Globally, around 24 billion tons per year of garbage being dumped as a result of the linear economy, much of it ending up in unmanaged landfills (Callun, Dhafer, Matthew, Amir, & Mostafa, 2022) . United Nations in its reports “The role of business in moving from linear to circular economies” (UNEP, 2021) clearly exhibits the elementary requirement for the transformation or transition. The report determines that, in addition to decarbonization, there is a chance to drastically cut resource consumption and pave the way for a future with lower carbon emissions and less environmental harm by quickly moving to a more circular economy that encourages reduced use of raw materials and redesign, reuse, repair, remanufacture, and recycling at every point of the value chain. By adopting a more circular strategy, businesses have a genuine chance to cut expenses, strengthen the robustness of their supply chains, adhere to new regulations, and satisfy investor and consumer demands. Businesses can do this by employing a value-chain strategy to take "transformational sprints" towards circularity and by prioritizing areas where they can act to have the biggest impact on greenhouse gas emissions. The value chains, which include all the activities that produce or receive value, such as designing, producing, distributing, selling, and consuming a product, must be transformed by businesses. “By moving to a more circular business model, businesses can: expand into new markets and gain market share; Lower expenses, lower risks, and future-proof the company; Promote innovation, draw in talent, provide value, and meet public expectations” (UNEP, The Role of Business in Moving from Linear to Circular Economies, 2022).

6.1 Case 3: The electronics value chain's circularity

“Electronic products are becoming commonplace; according to some projections, there might be 50 billion Internet-connected devices worldwide by 2020. Over 50 million tons of electronic garbage (also known as e-waste) is produced yearly by the creation, usage, and disposal of these products. By 2040, this quickly expanding waste stream is predicted to contribute 14% of the world's greenhouse gas emissions, and by 2050, it will weigh 120 million tons annually” (UNEP, Our planet is choking on Plastic, 2022). “The raw materials in this waste have the potential to be worth up to \$57 billion, but only 17.4 % of e-waste was properly recycled in 2019 (WHO, 2023).” The electronics industry can achieve near-complete circularity if electronic products are manufactured, recovered, repurposed, remanufactured, refurbished, and recycled according to Figure 6.

Figure 6: Circularity in electronics



[Figure Source: UNEP Report on the Role of Business in Moving from Linear to Circular Economies, Page no -19]

The lifespan of electronic equipment must be extended in order to accomplish this, and more standardized designs—also known as "design for disassembly"—that make repair and remanufacturing easier must be used. Businesses must simultaneously ensure that products that are no longer in use are collected. Electronic components are also recycled in accordance with tight regulations, and new products are made using a greater percentage of recyclable and recycled materials. Every year, consumers discard millions of electrical items, including cellphones. Producers of environmentally friendly cellphones are devising creative methods to maximize the resources used in their production. Infrastructure for disassembly, refurbishing, remanufacturing, and recycling is necessary in every country where items are utilized, in addition to improvements and extensions in recovery networks.

Increasing the lifespan of electronic devices can also be accomplished by employing innovative business methods that promote reuse or provide electronics as a service. Enhanced dependence on cloud computing may aid in the "dematerialization" of electronics and reduce the requirement for new parts and merchandise. A collaborative effort by product designers, resource extractors, manufacturers, distributors, service providers, investors, customers, and recyclers can result in improvements to electronics' longevity and ensure that their value is maintained long after their original useful life has finished.

To understand the global electronics value chain we have to go through the stages as follows:

- a) Extraction of raw materials (by big mining firms and regional small-scale artisanal miners)
- b) Manufacturing (components, processes, materials, modules, and systems), financial institutions, researchers, and innovators
- c) Distribution (suppliers of logistics and service providers)
- d) Utilization and recycling
- e) Recovery, assembly and sorting, renovation, remanufacturing, recycling, or disposal; means end-of-use (both official and informal collectors).

Companies play a critical role in aiding the transition to a circular and sustainable economy, because they are significant stakeholders at every level of the electronics value chain, from the extraction of raw materials and product manufacturing to the collection and recycling of e-waste, companies play a critical role in aiding the transition to a circular and sustainable economy. Businesses engaged in the mining and refining industries, particularly small-scale miners and refiners, should follow regulatory requirements and best practices to lessen their adverse effects on the environment and society. Product designers and producers should try to deliver more durable products that are easy to disassemble, remanufacture, and repair at a low cost. Global businesses should be cautious about their supply chains, attempting to end informal mining wherever possible, recycling the waste from mining, and ensuring that people who work along the entire value chain have fair working and living conditions. "In order to recover and collect e-waste and to develop buy-back, take-back, and incentive programs for end-of-life electronic products, manufacturers, retailers, and distributors should make use of distribution and sales networks. In addition to working with informal waste collectors, collection and recovery companies should make sure that all e-waste fractions are collected, regardless of the materials' possible market value (UNEP, Circular Approach, 2022)." It is imperative that recyclers must control e-waste fractions containing materials of concern in an environmentally appropriate manner to avoid hazardous emissions or discharges.

Most importantly, the exchange of new and used goods is an essential component in the electronics value chain which demands consideration by the business. "To guarantee that electrical and electronics brands assume accountability for redesigning, refurbishing, remanufacturing, recycling, and recovery needs in nations where manufacturing infrastructure is not available, EPR (Extended Producers Responsibility) schemes must be established (OECD, 2023)." Additional in situations where EPR schemes are not yet required or created, multinational electronics manufacturers should take responsibility for their global value chains and uphold the ideals and concepts of EPR regulations in more developed jurisdictions.

Converting electronics to a circular economy: Large electronics companies have extensive global networks for selling their products, but little infrastructure has been invested in managing the EOU (end-of-use) of these products when they are sold abroad, particularly in developing nations where there are

no facilities for recovery, recycling, or remanufacturing. “PACE (Partnering to Accelerate Entrepreneurship) and other initiatives have defined actions to help accelerate the transformation to a circular economy and to make it as impactful as possible (USAID, 2022).”

In light of above initiatives it should integrate and advance decent work. When the electronics industry transitions to a circular economy some useful actions are recommended for the companies, such as - encourage and assist circular product design; permit manufacturers to procure more recycled materials; direct and assist new business models to achieve a triple-win in terms of the environment, finances, and society; motivate customers to take part in bring-back programmes; establish efficient systems for product recovery and collection; Promote effective and transparent cross-border movement that complies with regulations; arrange sorting, pre-processing, and recycling activities strategically; and raise incentives for spending money on facilities and technologies for recovery, collection, or recycling (UNEP, Circular Approach, 2022).

7. CIRCULARITY IN THE FIELD OF MANUFACTURING

Manufacturers create reusable products in a circular economy. The design of electrical devices, for instance, makes repairs to them simpler. Reusing goods and raw materials is also prioritized. Some examples are illustrated here in support of circular economy in the manufacturing.

7.1 Case 4: Dutch start-up — COCO Automotive

COCO Automotive was named one of the top 101 automotive start-ups in the Netherlands for trying to extend the lives of vehicles. They redesign and rebuild cars, replacing combustion engines in existing cars to turn them into electric vehicles. When refurbishing a car, COCO Automotive reuses materials using the old car frame and other existing components. The refurbished car uses far fewer new materials and little energy when compared to manufacturing a brand-new car. This creates a low-impact alternative vehicle that eschews fossil fuels. The high cost of new electric cars, which are more expensive than combustion cars, has been a significant barrier to mass adoption. COCO Automotive is providing a way for people to get an electric vehicle for less, speeding up the abilities of societies and countries to meet their climate goals (Cotec_technology, 2023).

7.2 Case 5: Circularity in the tire manufacturing ecosystem

The number of ‘end-of-life’ tires commonly known as ELTs or ‘end-of-use’ is increasing as more vehicles hit the roads each year (WBCSD, 2008). Synthetic rubber, a major component in tires, is made of plastic polymers that don’t decompose quickly. ELTs are a major global issue that causes carbon emissions, pollution, and health risks. “European Union introduced a series of directives to reduce the negative environmental impact of the automotive sector. Some of its stipulations were adopting a circular economy, recycling / reusing a minimum of 85 per cent by weight per vehicle, and recovering at least 95 per cent by weight per vehicle (EU_Brussels, 2023).” Several leading tire manufacturers have responded by setting up individual initiatives, many of which focus on replacing fossil-fuel-based virgin Carbon Black (vCB), which constitutes about 21-22 per cent of tires. Tire manufacturers can use up to 20 per cent of rCB instead of vCB without loss functions, limiting carbon emissions and ensuring less use of fossil fuels. Four such collaborations and initiatives that engage supply chains are discussed below (Cotec_technology, 2023):

- “**Michelin and Bridgestone** presented their shared vision in November 2021 to make tires 100 per

cent carbon neutral and sustainable by 2050. In the vision, the two companies focused on promoting the use of recovered Carbon Black (rCB) in the tire industry. The initiative addressed challenges like the absence of a global method to standardize rCB, new technologies, fragmented market, and recycling capacity (MICHELIN, 2023)”.

- **Orion**, a global supplier of vCB, wants to replace fossil fuel feedstock with 100 per cent renewable material and has set a schedule of milestones to be achieved between 2025 and 2050. They have already released a high-reinforcing rCB.
- **Nokian** tires aim to make tires with 50 per cent of recycled or renewable raw materials by 2030. Their new concept green tire unveiled in 2022 has 93 per cent sustainable materials, including rCB, recycled steel belts and wires from ELTs, and natural rubber.
- **Goodyear** wants to source its raw materials sustainably. As part of the strategy, they’re increasing the amount of sustainably grown soybean oil sourced to substitute petroleum-derived oil to keep tires pliable. Goodyear wants to replace petroleum-derived oil completely from its tires by 2040.

8. CONCLUSION

For sustainability and the lifecycle of resources, a paradigm shift that involves radical process re-engineering, product development, selling, and distribution along with responsible use and disposal is necessary. There are a finite number of natural resources, such as different minerals. In addition to depleting the finite natural resources, their usage in producing items for human use has an impact on environmental factors, some of which have negative consequences on the environment. The availability and usability of natural resources for the creation of new value may be enhanced by putting the circular economy concept into practice. Consequently, every government, business, and individual must participate in the transition from a linear to a circular model of production and consumption.

Circular business strategies that extend the life of a product or provide access to services are likely to attract a greater number of clients. A circular economic model provides a means of meeting customer needs while consuming fewer resources, which can contribute to higher profits. In 30 years, it offers the chance to achieve a "near-zero waste" economy with a significantly reduced carbon pathway that enables companies to "build forward better" (Mingyu, Lin, Wang, Goodluck, & Ahmed I., 2022). This brief analysis demonstrates that companies must take action instead of holding onto the hope that their out-dated business models will continue to be successful. Knowing how to achieve full circularity while retaining business value is essential to changing the global economy in that direction. There are significant potential in the electronics value chain. The provided examples illustrate solutions that have worked, even though they don't cover every potential approach for firms to become more circular and resource-efficient.

Future success is generally expected for businesses that offer exceptional value at minimal resource and environmental costs and move swiftly toward nature-positive solutions and net-zero carbon emissions. Circularity principles ultimately have the potential to help achieve this goal. Making the swift transition to manufacturing things and offering services that are zero carbon, waste-free, pollutant-free, and contribute to biodiversity restoration is a more commercially viable strategy for all businesses. Companies are showing more and more that this approach can be implemented in less than a generation. Together, we should all strive for this. Its high time businesses started aiming for circularity.

Therefore, one might suggest that the circular economy is a novel and revolutionary idea for the 21st-century economy, offering an excellent solution to the environmental disaster and climate change on a

worldwide scale. A circular economy takes a fundamentally different tack when it comes to all aspects of the economy, including social responsibility, more consistent economic growth, and the sustainable use of natural resources. In this context, the idea of the linear economy is essentially eliminated since it has grown too costly and is no longer viable in the long run in terms of raising competitiveness. The fundamental tenet of the shift from a linear to a circular economy is a feedback loop that recycles and collects waste and feeds it back into the cycle of production as useful raw materials. A single kind of waste can be recycled multiple times and used again in later cycles of production processes, depending on technological features.

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