

Book Chapter

The Paradigm of Circular Economy and an Effective Electronic Waste Management

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Abstract

Zero waste management is a holistic concept that recognizes waste both as a resource and a measure of the inefficiency of our modern society [1]. While the traditional waste management system considers waste an 'end-of-life' product consumption, zero waste challenges this notion by recognizing that waste transforms resources in the intermediate stage of the resource consumption process [2]. In this context, the most critical aspect of creating a zero-waste city is shifting from a linear economic model to a circular economy. According to a recent study, only 9 percent of the global economy is circular (reused or recycled into products). The other 91 percent follows a linear model of making and taking waste. This study investigates the role of effective e-waste management as a crucial part of a circular economy. Accordingly, this study offers insights into the role of the circular economy by presenting a successful implementation of the circular economy.

Keywords

Circular Economy; E-Waste Management; Urban Mining; Extended Producer Responsibility

Introduction

Goal 12 of the UN's Sustainable Development Goals (SDGs) aims to promote sustainable consumption and production patterns through measures such as specific policies and international agreements on the management of materials that are toxic to the environment. Also, according to the UN Global e-waste monitor report [3], the consumption of Electrical and Electronic Equipment (EEE) is strongly linked to overall global economic development. However, the amount of electronic waste (e-waste) produced globally in 2019 reached an alarming record of 53.6 million tonnes (Mt), up 21 percent in just five years [3].

Electronic wastes contain many hazardous materials that can harm individuals and the environment if mishandled [4]. For

instance, landfill leachates can carry poisonous chemicals into sewage systems and groundwater, whereas combustion activities regarding incineration are responsible for emitting hazardous gases into the atmosphere resulting in pollution [5]. In developing nations, backyard activities related to recycling, reuse, and refurbishing Waste Electrical and Electronic Equipment (WEEE) lead to overexposure to harmful substances, especially in workers employed in informal facilities [5]. Informal facilities for e-waste management are scattered in developing nations, and in most countries, the recycling rates in these facilities are approximately 30 to 50 percent of the global rate [6, 7]. In many developing nations where e-waste collection rates are insufficient to meet the demands, informal facilities ensure that their e-waste is diverted from a landfill and goes through the correct recycling procedures [7]. In many countries where the informal division reuses and refurbishes electronic waste, these actions allow the e-waste to stay within their region's metabolic infrastructure for carefully tracking and reflecting the concept of a sustainable urban location.

The most critical aspect of creating a zero-waste city is shifting from a linear economic model to a circular economy [8]. According to a study conducted by the World Economic Forum in 2019, only 9 percent of the global economy is circular, which means that only 9 percent of items are reused or recycled into products [9]. The other 91 percent of the economy follows a linear model of making and taking waste [10]. Figure 1 provides an overview of the material flow needed in a circular economic model where a product's end-life or waste is treated for its resources and utilized for a region's metabolism. Moreover, it is crucial to demonstrate that collective strategies and regulations are needed to create efficient and sustainable management systems because they represent a city's presentation.

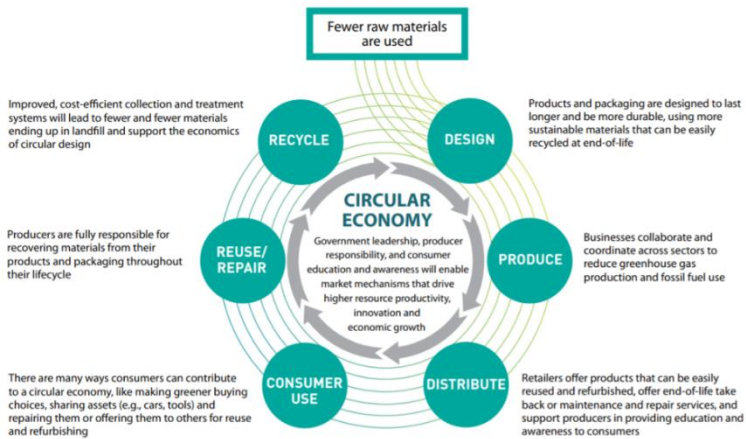


Figure 1: Material Flow in a Zero-Waste City. Source: Ontario’s Strategy for a Waste-Free Ontario: Building the Circular Economy [11].

Below is an explanation of each of the components involved in the circular economy:

- **Few raw materials used:** Most of the raw resources used are extracted, and products are manufactured, used, and disposed of. As a result, there is a shortage in raw materials, large quantities of waste, and a plethora of environmental issues. Throughout a circular economy, products and materials stay within the circulation. As a result, fewer virgin materials are utilized compared to the traditional linear economy. Furthermore, products are greater in value, and less waste is produced. The goal is not just to create long-lasting end-of-life recovery but also to lower the use of virgin materials and energy through a restorative system.
- **Recycle:** In this phase, products are collected, separated, and dismantled to remove any toxic substances and ensure that secondary raw resources are of high quality and can be reused. Ultimately, in a circular economy, the objective is to go beyond traditional recycling practices. For example, a product is only taken for recycling if it cannot be reused, repaired, recreated, or refurbished.
- **Design:** This component refers to how products (including electronics) are part of a cyclable and sustainable

production. Specifically, products must be manufactured to be durable, incorporate modular design, and can be dismantled easily. Additionally, no pollutants are used to cause environmental damage, and lastly, materials should be safe, separable, recyclable, and reused.

- **Produce:** The circular economy is a collaborative and team effort. Its goals can only be reached if stakeholders encompass the interaction with citizens and groups that may be affected by circular policies and regulations—creating strong partnerships that are beneficial for communities for constructing economies of scale for diversion projects. Such partnerships can lead to cost-sharing, improving infrastructure, implementing new waste reduction plans for industries, and lowering GHG emissions and fossil fuel usage.
- **Distribute:** As we lessen our dependence on virgin materials, significant value is added to the economy by generating or increasing the reuse and reproduction industries. Companies collect, separate, and process recovered waste materials, and such businesses also create and redistribute these products made from recovered materials. As a result, such items benefit from expanding markets and consumers in these regions.
- **Consumer use:** Customers are essential stakeholders in the circular economy; hence they have a significant role in its success or failure. For example, consumers can make eco-friendly choices by buying environmentally sustainable products, sharing assets, and even choosing to self-repair their obsolete electronics.
- **Repair/Reuse:** *Reuse* refers to a product that is still functional and can be passed on to other users or the owner. *Repair* refers to extending the longevity of a product through advanced refurbishment and repair and efficient second-hand markets. Repair/reuse initiatives and businesses are crucial as they are beneficial for the environment in most cases due to the fact that energy, water usage, and chemical are needed for recycling procedures, hence straining the system.

The Financial Sustainability of E-Waste Management

Economists have mostly directed their attention on the different types of capital that one acquires and withstands, which can take the form of natural, social, artificial, or human [12]. This is why economic sustainability has largely been associated with well-being in the framework of sustainable development [13]. Well-being is often defined as the state of being content and satisfied by consuming goods and services [10]. Hence, sustainable development is imperative for the well-being of individuals because it requires an increase in consumption for economic prosperity [14]. In other words, forming a financially sustainable e-waste management system involves maintaining economic resources that should not hinder the economic prosperity of upcoming generations [13]. The assets that are required for e-waste management consist of technologies needed for its collection and disposal, planning and fiscal resources required for policy implementation, and capital required for public awareness. It is important to remember that creating ways to incorporate the vast amounts of capital needed to financially sustain such a system is difficult as many governments need to agree upon the most suitable way towards e-waste management. Moreover, initiatives can vary from government programs to informal recycling practices within free markets.

The Economic Worth of E-Waste

Although e-waste poses a considerable problem for countries all across the globe, it should not be surprising to state that it is a golden opportunity for global economies. There is no doubt that e-waste holds great financial value due to the number of substances found within each piece of WEEE, such as silver, gold, platinum, palladium, etc. [15]. To put this into perspective, a typical smartphone contains 100 times more gold than a ton of gold ore [15]. Moreover, as most WEEE is disposed into landfills, these sites are a goldmine of valuable materials, so more action must be taken to retrieve these resources [15].

In 2017, approximately 1.46 billion smartphones were vended in markets [16], and each smartphone comprises electrical parts valued at more than \$100.49 [15]. From an economic viewpoint, this value holds a lot of weight in the markets annually. Additionally, if only the raw resources are recycled from WEEE, the amount would be valued at more than \$11.5 billion [17]. Current research has demonstrated that the total economic worth of e-waste is \$62.5 billion yearly which is higher than the GDP of many nations [15]. The best way to make use of these electrical items is to ensure that the resources found in e-waste are not extracted and wasted; rather, they should be valued and reused in order to keep the resources at higher market prices [15]. World markets that are dedicated to smartphones are advanced, especially at the top end of the market, but enhancements are needed [15]. In 2016, 435,000 tons of smartphones were disposed of with components worth a fortune [18]. This showcases that it is crucial that the electronics and waste management industries shift towards a circular economy [18].

Transformation towards a Circular Economy

Most standard waste management systems and the movement of resources are built upon a linear make-use-discard structure where the materials are created from virgin sources, consumed, and then sent to a landfill [11]. This system has become the typical model for many countries for the longest time, including Canada. It has led to a 19 percent rise in GHG emissions from 1990 to 2014 due to wastes being discarded into landfills [8]. Moving away from traditional waste management systems, a circular economic model aspires to eradicate waste from recycling procedures and through the lifespans of products and packaging [11]. Its main objective is to increase value and eliminate waste by enhancing the architecture of products, business structures, and materials [11]. Furthermore, the aim is to go a step further than recycling practices. Eventually, the circular economy model's target is not only to create sustainable products with improved end-of-life recovery but also to reduce the utilization of virgin materials and energy consumption in order to build a resilient and restorative model [11]. The

following sections will discuss the necessary aspects that are required to construct a circular economy for electronics: design and reintegration of manufacturing scrap (manufacturing), repair and durability (life extension), higher product collection and return with incentives for consumers (end of life), and advanced recycling and recapture (sourcing).

World Economic Forum [15] mentioned that the new circular vision for electronics contains the following five components.

- **Design:** Electronic products must be manufactured robustly so that consumers can reuse them [15]. Specifically, products should be lighter and smaller with enhanced digitalization and cloud-computing services. It is important to remember that many multinational corporations have pledged to eliminate wasteful components being utilized in their electronic supply chains. In contrast, other companies are committing to building electronics free of poisonous materials [15]. These aspects must be collaborated throughout the sector [15]. By creating better electronic designs, it can be confirmed that these products will be dispersed for longer timeframes and have prolonged lifespans leading to their reuse and refurbishment. Moreover, designing durable EEE through holistic methods will ultimately create greater value in a circular economy.
- **Reintegration of Manufacturing Scrap:** Many of the resources in electronics, such as precious metals, are reintroduced as newer parts.
- **Repair and Durability (life extension):** Right-to-repair regulations allow customers to have access to fix and amend their own electrical and electronic products. Such legislation advocates for enhanced product design and quality, accessible spare components and tools, and documentation for repairing devices. Ultimately, the objective is to extend the lifecycle of devices and reduce e-waste created from obsolete or unused products.
- **Higher Product collection and return with incentives for consumers (end of life):**
- The efficient collection of e-waste is a prerequisite for a successful circular economy. Global collection rates are

quite low, and only advancing production with improvements in the collection and recycling infrastructures will close the manufacturing and consumption loops. Hence, it is important to pay attention to and examine consumer behavior related to their collection and recycling habits. In addition, businesses need to provide consumers the necessary incentives and technology needed to ensure that electronics can be returned and fixed to last longer.

- **Advanced recycling and recapture (sourcing):** Many obstacles prohibit the economic viability of e-waste recycling, and investment incentives are limited. Governments must provide economic incentives to improve and scale-up recycling processes and increase investments in state-of-the-art technology. Such facilities must be planned carefully, considering capacity, location, and specialty. It must be noted that increasing the quantities of recycled materials in electronics production is vital for reducing the demand for new resources. This will allow producers to increase the sourcing of recycled materials.

Take-back and Return Systems

As mentioned previously, there has been a greater inclination to embrace Extended Producer Responsibility (EPR) models for the sustainable management of electronics and e-waste by encouraging governments and stakeholders to develop and implement take-back or return systems for older Electrical and Electronic Equipment (EEE). These models are also crucial for monetarily motivating customers and ensuring that their private information will be managed with care [15]. Additionally, knowledge of user experience and the interface can be utilized to make obsolescence techniques more efficient [15].

The stakeholders that are involved in the electronics industry largely include governments and the private sector (producers). These actors are responsible for developing a structure for closed-loop manufacturing where obsolete electronics are gathered, and their components are collected for renewal to produce new products. This will create novel economic incentives and policy approaches as well as allow the private

sector to take the initiative. Moreover, recycling facilities will also need to undergo systems upgrades because, in some instances, the recycled components within EEE need to be of better quality and may not be used in newer products [15]. Governments need to start implementing targets for this system, such as in China, whose goal is to produce electronic equipment with 20 percent recycled material by 2025 [15]. Closed-loop systems strive to reach sustainability by concurrently enhancing financial and environmental objectives and creating maintainable supply chains for electronics [19]. Regarding a circular economy, e-waste management is vital in the following areas.

Resilience and Repair

It is known that more than simply recycling Waste Electrical and Electronic Equipment (WEEE) is needed to fight this growing problem. Consumers need to profit from long-lasting and well-made electronics, which can be accomplished if they are refurbished and preserved. This puts the onus on producer companies to be prepared to fix the electronics they have sold, which has been legislated and is being enforced in some countries [15]. Used EEE are valued at higher prices than their individualistic parts, hence repair procedures are an advantage for a circular economy.

Urban Mining

Urban mining is used to recover the valuable materials embedded within e-waste. Thus, producers of electronic products must capitalize on state-of-the-art technologies that will assist them in recovering these resources. For instance, advanced mining and refining procedures in China have allowed the country to gain increased control over copper and cobalt, resulting in a recycling company mining more of those minerals from WEEE [20]. This is important, especially for electronics, because it would increase the quantities of resources from e-waste flowing into the economy that would be moved into the manufacturing of novel EEE [15]. However, it is important to remember that this can be obtained successfully once e-waste laws such as EPR policies as well as developing formal recycling

sectors are enforced in developing and developed countries. This will lower the negative externalities and propel financial prosperity.

Reverse Logistics

Once an electronic product reaches its end, its resources must be gathered, collected, and taken back so that its components can be refurbished for new products. This method is called a reverse supply chain [15]. In a typical forward supply chain, the flow and dispensation of materials are not supported by the value of a complete item with various features. Hence, it is largely dependent solely on the cost of the raw valuables, which requires a robust and competent reverse chain model that is secure and guarantees that resources do not flow into informal subdivisions [15].

The Social Sustainability of E-Waste Management

Generally, social sustainability is easier to measure and witness than the other two tenets of sustainability, but it is difficult to describe. The concepts and debates that revolve around social sustainability are complex and include conversations related to social inequality, cohesion [21], sustainable cities [22], and individuals' incomes [23]. In addition, arguments surrounding social sustainability in e-waste management are often divided, with discussions on informal recycling activities in developing nations.

In 2020, only 20 percent of e-waste produced internationally was handled by formal recycling sectors [17]. In developing countries where populations primarily consist of low- and middle-income earners, the most significant percentage of e-waste is handled by informal sectors with unsafe safety measures coupled with poor environmental conditions [24].

It must be remembered that there is no single description of the informal sector because of the differences in viewpoints and experiences that vary from country to country. In most of the

scholarly work, informal labor is explained mainly as "small scale [individual actions], labor intensive, largely unregulated and unregistered (often without trading licenses), associated with evasion of taxes and low technology processing" [25]. Regarding e-waste management, this description encompasses practices conducted for earning basic livelihoods and are commonly denoted as *subsistence activities* [26]. Furthermore, due to the fact that there are many actors involved in the informal sectors with varying levels of power depending on their place in value and supply chains, informal shareholders have various earnings [27]. A point to bear is that the informal laborers conducting e-waste management activities such as collection, dismantling, sorting, exporting, and trading materials are at the lowest level of the social hierarchy. Most of these individuals are from marginalized and vulnerable communities with no other source of economic opportunities [27]. Moreover, other individuals may have successful but unregistered businesses, which can bring higher profits due to services related to repair, reuse, and specialized dismantling of resources in e-waste [27]. In these cases, because many of these businesses are unofficial, individuals are required to operate them on the parameters of legal measures, which is an issue in itself [27]. Thus, it is important to develop and maintain partnerships between the formal and informal divisions in order to create sustainable and effective systems for e-waste management.

These heavily rely on government policies and laws regarding e-waste collection, recycling goals, and initiatives. For example, generators of e-waste can be compelled to meet a specific collection and recycling quota for WEEE especially in management systems that are built on EPR. Moreover, larger companies that manufacture electrical and electronic products are required to meet recycling objectives that align with Corporate Social Responsibility (CSR) regulations [27]. In a few EPR systems for e-waste, the responsibility for collecting and recycling EEE is mainly administered to Producer Responsibility Organizations (PROs). PROs are entities that function as compliance providers accountable for ensuring that the lawful recycling and collection targets are met by producer corporations [24]. These objectives can only be reached once there is enough

access to e-waste. Because the informal sector is more successful in collecting WEEE than the formal sectors, the integration between the two can be beneficial in more ways than one [27]. Firstly, PROs and the manufacturers of EEE can adopt the informal sector's practices that can assist them in fulfilling their collection and recycling goals and meeting the requirements for achieving their CSR targets by improving the professional environment of workers [24]. Another benefit is that many customers require that their electronic and electrical products be eco-friendly and made with certified sustainable materials. Keeping this in mind, current e-waste management systems need to incorporate comprehensive mechanisms for fostering healthy associations and will ultimately fulfill CSR requirements [27]. This is crucial because it allows for developing a transparent model of understanding and documenting where e-waste is being collected and recycled as well as who is accountable for overseeing the activities in domestic and global supply chains [27]. In addition, understanding the specificities of virgin sources and safeguarding their access can reduce risks in the management system, increasing the value of a PRO's functionality.

Public officials also need to form and maintain partnerships between the formal and informal divisions to create sustainable and effective systems for e-waste management. Governments are responsible for bringing stakeholders together and incorporating them under the umbrella of an already present legal blueprint which can assist in closing the gaps in which e-waste is discovered in unrestrained recycling divisions with a lack of safety protocols resulting in many environmental risks. Furthermore, the amalgamation of informal and formal sectors can lead to a greater approval of recycling models, and that can mitigate the social threats for officials [27]. Lastly, public authorities need to recognize the package of benefits linked with integrating the formal and informal sectors. Such co-benefits will be helpful for countries in accomplishing their state targets leading to higher employment and growth as well as prohibiting the dislodgment of informal employees from their working environments [27].

A Case Study

The concept and practice of shifting towards circular economies have been of growing interest across the world, especially in Europe. In March 2020, the EU embraced the *Circular Economy Action Plan*, which laid out a set of measures for various industries [25]. Many nations have adopted a legal framework for moving towards circular economies, such as the anti-waste legislation in France. However, the issue is that standardized indicators for quantifying and qualifying a circular economy make it challenging to examine and compare various countries or sectors. Despite this, and even if not at the center stage alongside Germany, the Netherlands, France, and Denmark, Switzerland is steadily creating and achieving immense milestones in moving towards a circular economy [28].

The Political Background and Problems with Instruments for Circularity

Recently in Switzerland, the push for transitioning towards a circular economy was propelled by its federal government when Parliament decided to devise a blueprint for conditions to motivate its advancement [28]. Over the years, the Swiss government has introduced numerous initiatives to encourage and promote the efficient utilization of resources, recycling, producer responsibility, etc. Because the country is not abundant in virgin materials, Switzerland has been pursuing a circular economy since the 1980s. It has achieved closing some loops, at least partially, because no formal institution exists for a circular economy [29]. The development of the climate fund for Switzerland's CO₂ Act may assist in making the changeover smoother and perhaps can be a potential circular economy measure for other initiatives which affect GHG emissions [28]. In 2018, the Swiss government introduced CES. This movement operates as a sort of project incubator and sees itself as a path for cooperation and conversations between stakeholders involved in the circular economy. Additionally, it is a platform that provides insights for various actors, such as public agencies, start-up companies, and SMEs, for creating and being an essential resource for devising circular solutions [28].

Many legal adjustments have occurred in Switzerland, mainly in the field of waste management, processing, and consumer goods sectors:

- Modifications in the Swiss Environmental Protection Act: The Swiss Federal Council now has the authority to stop the promotion of virgin items if their extraction techniques have the potential to negatively affect the environment or compromise the sustainable usage of natural resources [28].
- Regulatory changes on public procurement: In January 2021, the contracts awarded by the Confederation and its enterprises are not only supposed to be based on lowered costs but must also include the notions of sustainability [28].

The Economic Background and Circularity Problems with Resources

Switzerland has been developing its markets for a circular economy for the longest time, so an important question is just how sophisticated is the country's circular economy. Today, a fundamental unit for measuring circularity is based on the ratio between the recovered materials and the total amount of consumed materials [30]. This is known as the *circular material use rate* or *circularity rate*. In 2018, the circularity rate for Switzerland was 13 percent and had been increasing steadily since 2000 [30]. It is important to bear in mind that in 2018, all waste materials that were treated could be reused (2.7 tonnes/individual); it only comprised one-fifth of the materials requirements for the Swiss economy (13.1 tonnes/individual). Although recovery of materials and their reuse are essential tools for circular economies, these should not be the only options for the flow of raw items through recycling. Strategies for lowering mass consumption rates should also be adopted into the country's business models to mitigate environmental impacts. Furthermore, Switzerland has very high import rates, with approximately 60 percent of its environmental effects caused by the manufacturing and processing of goods consumed in the country being imported to other nations [31, 32].

To understand and assess the environmental effect of a specific product, Switzerland has created an ecological saturation method where units are defined as ELUs. This method can be utilized by placing an actual number for showcasing a product's environmental effect, which Switzerland can use for comparisons with global targets with other countries as well as its own [28].

Repairing not Recycling as a Solution to Combat E-waste from Smartphones

Smartphones pose a significant issue in Switzerland because of their low recycling rates. Smartphones can potentially be less harmful to the environment if one reconsiders their lifecycles and looks towards solutions beyond recycling. Although recycling such devices is needed when they reach their maximum lifespans, using and keeping smartphones for longer timeframes allows their materials to be used longer and lowers waste streams, reducing the energy needed to process them at recycling facilities. Hence, the main goal for stakeholders should be to innovate ways to increase the lifespans of smartphones to lower e-waste quantities. In many countries, smartphones are replaced every three years. Research has shown that, internationally, increasing the lifecycles of smartphones by 33 percent (e.g., replacing every four years instead of 3) can avert annual GHG emissions that are equal to the emissions generated by Ireland [33]. Moreover, 60 years of smartphone ownership coupled with increasing their lifespan from 3 to 4 years would showcase a transformation from 20 to 15 - a 25 percent reduction in the number of smartphones utilized [33].

The idea of repairing smartphones for reuse is practical but complex in reality because prolonging the lifespans of these devices is a challenge in itself. Many producers have developed smartphones through planned obsolescence to ensure that they function for a particular number of years, thereby propelling forthcoming sales. Similarly, smartphones are not engineered with the thought of reuse or repair, making it challenging to exchange malfunctioning components. Those who support the repair and reuse of smartphones also face hurdles. Firstly,

producers of these devices need more resources and infrastructure, such as refurbishment facilities, to repair at larger scales (however, this may be accomplished at the retail level). Moreover, producers are also hesitant to provide extra components to third parties to have control over their repair services and may even raise prices leading to unaffordability for customers. In effect, customers have limited access to repair services and may need more insight into the costs and which services are beneficial. Thus, to lower e-waste quantities, repairs need to be affordable and appropriate for customers, service providers, and developers.

The landscape around customers access to repair services is transforming steadily especially in Europe as the country strongly aims to build a circular economy. A company by the name of *Fairphone* in Amsterdam has gained immense popularity over the years through its work on repairing and upgrading smartphones. The company primarily seeks to include modular design into smartphones by replacing obsolete components that can be exchanged individually and then restored for use in novel or refurbished smartphones or even other devices [30].

As repair services are increasing and becoming more accessible for customers, many markets are allowing such services for better outreach, which means that customers are more aware of picking options catered to repair quality and its costs.

Countries worldwide are devising new and innovative ways to combat the e-waste problem by finding options other than recycling [33-38], many of which Switzerland and Canada both can learn from and adopt these policies for the future. The situation in the EU has also gained attention after the country launched its *Right to Repair* initiative in alignment with its *Circular Economy Plan*, which has brought changes to the country. On the other hand, France created a reparability index in 2021, which looks to educate consumers on simple methods for repairing their electronics, giving customers a mandatory demonstration of clear information on the reparability of their non-functional EEE [39]. Sweden has also looked at utilizing

financial initiatives by introducing tax incentives of about 2500 euros for fixing appliances, and similar schemes are present in Austria [39]. The concept of incentivizing repair showcases opportunities for customers and manufacturers. Once the repair is incentivized, it encourages service providers to enter the market, creating greater competition and lower customer prices. Moreover, self-repair is also easily accessible for different devices as the repairability and scope of spare components and instructions are increased [39]. It is important to note that right-to-repair initiatives should also align themselves with a device's system upgrades so that manufacturers do not reject upgrading software after a certain period. These changes would allow for prolonged usage of smartphones which would have been deemed unusable.

Transformations are also required in contemporary business models. Because smartphones are vended through three- and four-year contracts, these agreements can take the form of leases where customers return their phones once their warranty expires. This system would allow producers to take back the virgin resources within phones and refurbish them for several years [39].

Conclusion

With the rapid development of the economy and population growth, waste disposal and in particular e-waste has become a hot issue of global concern [40]. For example, by 2025, the annual global generation of municipal solid waste will be approximately 2.2 billion tons and 4.2 billion tons by 2055 [41]. As such managing e-waste towards zero-waste is a challenging task for many years to come.

All in all, the main services that a complete electronic waste system must include in order to ensure sustainability are 1) collection of e-waste, 2) recovery of items such as virgin materials and metals, and 3) segregation and safe disposal of hazardous substances. The costs associated with unprofitable techniques as well as administration, monitoring, and control are essential for a functioning circular economy and maintaining

quality of the system. Governments need to bring stakeholders together to assist in closing the gaps by focusing on safety protocols and environmental sustainability strategies for net-zero wastes.

Many nations in Europe have adopted a legal framework for moving towards circular economies, such as the anti-waste legislation in France. Despite this, and even if not at the center stage alongside Germany, the Netherlands, France, and Denmark, Switzerland is steadily creating and achieving immense milestones in moving towards a circular economy

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