



Chapter 19

E–Waste Management: A Transformation Towards a Circular Economy

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ABSTRACT

The global accumulation of electronic waste is a growing concern in terms of the health and safety of our planet. Electronic waste has a greater potential to create environmental contamination and human health problems due to the way it is often disposed of, making it a worldwide problem. ‘Sustainable consumption and production’ may help nations solve the problem of electronic waste management by forcing them to make fundamental changes in the way their communities manufacture and use commodities. Governments, NGOs, businesses, and citizens all work together to change unsustainable consumption and production habits. The effects of e-waste on human health and the natural environment will be discussed, as will various situations involving this kind of garbage. Developed and developing nations’ (namely India’s) approaches to managing discarded electrical and electronic equipment will be examined, as will appropriate pathways concerning recyclable components using extended producer responsibility that led to the creation of a circular economy.

DOI: 10.4018/978-1-6684-8117-2.ch019

INTRODUCTION

By 2045, it is projected that “Waste electrical and electronic equipment (WEEE)” or e-waste would have doubled as the fastest-growing waste source worldwide (Mor, Sangwan, Singh, Singh, & Kharub, 2021). Due to the ever-increasing demand for electronic goods, which has imposed significant costs on both developed and emerging countries throughout the globe, this issue is rapidly expanding into a worldwide crisis (Innocent C. Nnorom & Odeyingbo, 2019). Knowing the exponential growth rate of electrical and electronic equipment, which is three times quicker than that of other solid wastes, is a given (Das, 2013). E-waste consists of precious resources and dangerous components; thus, it must be handled with care as e-products have become more sophisticated and integrated into daily life (Iyyanar et al., 2023). But the garbage collection and management systems have not kept up yet, so there is a danger of resource loss and adverse effects on the environment and human health from improperly collecting and managing e-waste (Ahirwar & Tripathi, 2021; Halim & Suharyanti, 2019).

Many, often contentious, definitions of “e-waste” have been proposed. As stated in a UNEP study, “E-waste is a wide word that comprises a spectrum of electrical and electronic equipments which may be rendered as end-of-life electronic gadgets and do not entail value to their owners (Krishna & Saha, 2022).” Waste electrical and electronic equipment are sometimes referred to as WEEE. According to European Directive 2002/96/EC, “all trash electrical and electronic equipment, including with all its components, subassemblies, and consumables which constitute part of the product at the time of discarding.” Any electric equipment that has reached the end of its useful life is considered “e-waste” by the OECD (M. V. Kaushik, 2018).

When it comes to its contents, WEEE is anything from uniform or simple; it includes both hazardous and non-hazardous materials and spans a wide range of classifications (Bhutta, Omar, & Yang, 2011). Electrical and electronic equipment include a variety of valuable materials that may be extracted via the process of e-waste recycling. As a result, WEEE recycling is a hot topic in the waste management and resource recovery communities (Pandey et al. (2023). To preserve natural resources and build a long-term solution for e-waste management, it is necessary to first identify and quantify valuable elements and dangerous compounds in order to understand the material features of this waste (Wath, Dutt, & Chakrabarti, 2011).

Electrical and electronic goods manufacturers often release new models on a regular basis. In addition, these items are made in a manner that limits their usefulness over time. Printed circuit boards are an integral part of almost all modern electrical and electronic devices (PCBs) (Bhatia & Baruah, 2020).

The concentrations of copper and gold in PCBs used in standard desktop computers are far higher than those found in either copper or gold ore, at around 20% and 250 g/t, respectively (Saravanamurthy, E, Sarangan, & Bharathkumar, 2018). Solutions based on physical, pyrometallurgical, bio-metallurgical, and hydrometallurgical techniques are available for recovering these metals from electrical and electronic wastes (Saravanamurthy et al., 2018).

Results have been usually dismal, despite a very well-established waste management infrastructure and significant collaborative efforts. This may be connected to the fact that not enough research has been put into developing evidence-based design tools, strategies, and technologies for recovering lost items (Constantinescu et al., 2022). Circular economy is seen as an innovative way to deal with the e-waste problem, which may help fix the aforementioned problems (Patel, 2021). With the help of circular economy incentives, manufacturers may restructure their operations and redesign their technologies to save money; however no anticipated incentives have been sought for the deployment of an EPR-based

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