Chapter 19
Technological Advancements in E-Waste Management Methods and Models

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ABSTRACT

In response to the rise of electronic trash on a worldwide scale, numerous new solutions have emerged. To recover valuable elements from electronic trash, many recycling processes have been developed, including mechanical, chemical, and biological methods. The use of artificial intelligence and machine learning algorithms in automated sorting systems has increased the operational efficacy of e-waste recycling dramatically. Urban mining has gained popularity as a potential method of obtaining precious metals from technological trash. Furthermore, the implementation of extended producer obligation (EPR) rules imposes obligation on producers for the correct management and disposal of their products. These technology advances collectively lead to more sustainable and effective electronic waste management, decreasing environmental impact and aiding the recovery of valuable materials.

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INTRODUCTION

The term "e-waste" refers to a wide range of electronic and electrical equipment that has been discarded, including commonly used devices such as smartphones and laptops, as well as less noticeable household appliances like refrigerators and washing machines (Oswald & Reller, 2011). The 21st century has experienced an unprecedented proliferation of technology, resulting in the integration of electronic devices as an inseparable component of contemporary existence. Technology has significantly transformed various aspects of our lives, including communication, work, and daily living, through the utilization of microchips in smartphones and the operation of large-scale data centers that support the digital era. Nevertheless, the rapid and exponential proliferation of electronic devices in both production and consumption has concurrently engendered a significant and urgent global concern, commonly referred to as electronic waste or e-waste. These technological devices, previously lauded for their groundbreaking features and practicality, ultimately reach the conclusion of their operational cycle, necessitating their proper disposal. The increasing global demand for electronics has led to the emergence of a complex and multifaceted issue regarding the management of electronic waste(Tesfaye et al., 2017). This issue extends beyond environmental considerations and encompasses broader implications for health, economy, and society.

The exponential increase in electronic waste poses a significant and complex global issue, influenced by various factors that highlight the contradictory nature of technological advancement. Based on the findings of the Global E-waste Monitor 2020, it was determined that the global production of electronic waste (e-waste) amounted to approximately 53.6 million metric tons in the year 2019. It is projected that this volume will increase by 21% to reach 74.7 million metric tons by the year 2030 (Yu et al., 2010), provided that current trends continue. The current surge of electronic waste presents a multitude of significant challenges that require urgent attention and creative resolutions.

Figure 1. Global e-waste forecasting statistics
Source: https://ewastemonitor.info/gem-2020/