

# Application of Material Flow Analysis (MFA) in Electronic Waste (E-Waste) Management: A Review <sup>†</sup>

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**Abstract:** This paper reviews around 41 articles providing the trends, characteristics, research gaps and challenges of these studies that may help e-waste management-related academics and practitioners with an overview of the need for such tool to be applied. The results and highlighted future research perspectives discussed in this study will definitely help to analyze e-waste management systems with more critical aspects, i.e., hidden and known flows of waste products and associated materials, economic assessment of material recovery and the role of responsible authorities.

**Keywords:** e-waste; waste electrical and electronic equipment (WEEE); material flow analysis (MFA); circular economy; sustainable development

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## 1. Introduction

“E-Waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of re-use” [1–4]. Material flow analysis (MFA) is one of the invaluable tools that is used by the developed countries to manage the complex waste stream [5]. According to Streicher-Porte et al. [6] “*Material flow analysis (MFA) is a term used in analyzing flow of matter (compounds, chemical elements, materials or commodities) which supported by material balancing that represent the material conservation law*”. Numerous papers have been published in this issue, however, there is a need for comprehensive understanding on where, why and how MFA is applied for e-waste management system. The aim of this article to explore the application of MFA in e-waste management with certain categorization, namely national level assessment, regional level assessment, product level assessment, material level assessment.

## 2. Material and Method

With an extensive search in the Web of Science (WoS) database, a number of articles were identified for conducting this review. Around 1098 articles were retrieved with the keywords “Material Flow Analysis” or “material flow analysis (MFA)”. With a refined search using keywords, E-waste OR waste electrical and electronic equipment (WEEE), “End of life electronics”, “waste electronics”, total 69 research articles were found that matched the keywords. Afterward, manually, each paper was screened and only relevant papers were selected. In this selection total, 39 research articles were identified that matched our criteria.

### 3. Categorization of the Content

Figure 1 summarizes detail mapping of the articles under 4 different categories. Articles analyzed in this study can be found in the reference list [7–43].



Figure 1. Detail mapping of MFA-E-waste research articles.

### 4. Discussion and Conclusions

E-waste is a growing environmental problem and requires much attention in managing it within the society. Both developed and developing countries are struggling to cope with the current level of generation. As the purchasing power is increasing among the population, generation of e-waste will continue to rise, mainly in developing Asia. Besides, developing countries have an incoming flow of foreign e-waste coming from developed countries, which made the situation worse. MFA is one of the most useful tools that are particularly helpful to identify different flows within the management system. This study provides a preliminary basis on how MFA has been used in e-waste management research. The identified studies presented here may be a valuable starting point for new researchers who are going to start working on this topic.

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