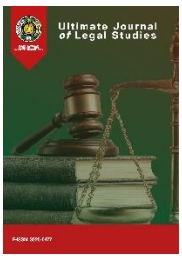
ULTIMATE JOURNAL OF LEGAL STUDIES (ULJLS)
Journal homepage: https://talenta.usu.ac.id/uljls



Legal Construction and Implementation of Electronic Waste Management within Indonesia's Environmental Law System to Support SDG 12

Danish Ammara[*1],Mhd Ridwan Tanjung[2], Rudi Heriansyah[3], Affila[3] https://orcid.org/0009-0009-9761-6306 , Rosmalinda[4] https://orcid.org/0000-0003-4058-6408

[1,2]*Faculty of Law, Universitas Sumatera Utara, Medan, 20155, Indonesia*
[3,4]*Lecturer Faculty of Law, Universitas Sumatera Utara, Medan, 20155, Indonesia*
[*]Corresponding Author: danishammara@students.usu.ac.id & affila@usu.ac.id

ARTICLE INFO

Article history:
Received : Oct 25, 2026
Revised : Nov 08, 2026
Accepted : Nov 09, 2026
Available online Nov 30, 2026

E-ISSN: 3026-0477
P-ISSN:

How to cite:
Ammara, D., Tanjung, M. R., Rudi Heriansyah, Affila, & Rosmalinda. Legal Construction and Implementation of Electronic Waste Management within Indonesia's Environmental Law System to Support SDG 12. Ultimate Journal of Legal Studies, 4(2), 68–79. https://doi.org/10.32734/uljls.v4i2.27765

This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International.
DOI: 10.32734/uljls.v4i2.27765

ABSTRACT

Electronic waste management requires a legal framework that addresses the hazardous characteristics of discarded electronic equipment while recognizing the potential for component reuse and recovery. This study examines the legal construction of electronic waste management within Indonesia's environmental law system and its implementation in Medan City, particularly in relation to Sustainable Development Goal 12. It employs a normative-empirical legal research method, combining statutory and conceptual approaches with qualitative data obtained through semi-structured interviews with eleven informants: two representatives of the Medan City Environmental Agency, two mobile-phone repair operators, and seven Universitas Sumatera Utara students. The findings indicate that electronic waste management is governed by interconnected provisions on waste management, specific waste, environmental protection, and hazardous and toxic waste. Minister of Environment and Forestry Regulation No. 9 of 2024 specifically classifies unused electronic goods as waste containing hazardous and toxic substances and establishes requirements for their management. Meanwhile, field findings reveal varied practices, including storage, repair, reuse, resale, transfer to collectors, and disposal together with household waste. Limited public access to information about appropriate collection and disposal channels, along with constraints in local government supervision, presents challenges to the implementation of the applicable legal framework. These findings highlight the need to strengthen coordination among relevant stakeholders and improve access to appropriate waste management facilities to support SDG 12, particularly Targets 12.4 and 12.5.
Keywords: Electronic Waste, Environmental Law, Legal Implementation, Medan City, SDG 12.

ABSTRAK

Pengelolaan sampah elektronik memerlukan kerangka hukum yang memperhatikan karakteristik berbahaya dari perangkat elektronik yang tidak lagi digunakan sekaligus mempertimbangkan potensi penggunaan kembali dan pemulihan komponennya. Penelitian ini bertujuan menganalisis konstruksi hukum pengelolaan sampah elektronik dalam sistem hukum lingkungan Indonesia dan implementasinya di Kota Medan, khususnya dalam kaitannya dengan pencapaian Tujuan Pembangunan Berkelanjutan ke 12. Penelitian menggunakan metode hukum normatif-empiris melalui pendekatan perundang-undangan dan konseptual, yang didukung data kualitatif dari wawancara semi-terstruktur terhadap sebelas informan, yaitu dua perwakilan Dinas Lingkungan Hidup Kota Medan, dua pelaku usaha servis telepon genggam, dan tujuh mahasiswa Universitas Sumatera Utara. Hasil penelitian

menunjukkan bahwa pengelolaan sampah elektronik di Indonesia diatur melalui keterkaitan ketentuan mengenai pengelolaan sampah, sampah spesifik, perlindungan lingkungan hidup, serta limbah bahan berbahaya dan beracun. Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 9 Tahun 2024 secara khusus mengategorikan barang elektronik yang tidak digunakan lagi sebagai sampah yang mengandung bahan berbahaya dan beracun serta mengatur tata cara pengelolaannya. Dalam praktiknya, penanganan sampah elektronik dilakukan melalui penyimpanan, perbaikan, penggunaan kembali, penjualan, penyerahan kepada pengepul, maupun pembuangan bersama sampah rumah tangga. Terbatasnya akses informasi mengenai fasilitas dan jalur pengelolaan yang tepat serta kendala pengawasan pemerintah daerah menjadi tantangan dalam pelaksanaan ketentuan tersebut. Temuan ini menunjukkan perlunya penguatan koordinasi antarpihak dan peningkatan akses terhadap fasilitas pengelolaan sampah elektronik untuk mendukung SDG 12, khususnya Target 12.4 dan 12.5.
Kata Kunci: Hukum Lingkungan; Implementasi Hukum; Kota Medan; Sampah Elektronik; SDG 12.

1. Introduction

Technological development has increased society's dependence on electrical and electronic equipment in various aspects of everyday life. Communication devices, computers, household appliances, and other electronic products support educational, economic, and daily activities (Faris Hadinata, 2024). The increasing use of such equipment, accompanied by technological advancement and shorter product life cycles, contributes to the growing generation of electronic waste (Baldé et al., 2024). This development generates electronic devices and components that are no longer used or have reached the end of their useful life.

Electronic waste (e-waste) has characteristics that distinguish it from ordinary household waste. Discarded electronic equipment may contain both valuable materials that can be recovered and hazardous substances that pose risks to human health and the environment when improperly handled (Grechanyuk et al., 2025). Components such as batteries, circuit boards, screens, cables, and other electronic parts therefore require management that takes account of their material characteristics and potential environmental impacts. Electronic waste management cannot be limited to collection and disposal; it must also address sorting, collection, transportation, treatment, and final processing.

The scale of this issue is reflected in global e-waste trends. The Global E-waste Monitor 2024 reported that global e-waste generation reached 62 million tonnes in 2022, increasing from 34 million tonnes in 2010. During the same period, the amount of e-waste documented as formally collected and recycled increased from 8 million tonnes to 13.8 million tonnes (Baldé et al., 2024). Despite this increase, formal collection and recycling accounted for only 22.3% of total e-waste generated in 2022. E-waste generation also increased almost five times faster than formal collection and recycling (Group, 2026). The report further projected that global e-waste generation could reach 82 million tonnes by 2030 if existing trends remain largely unchanged (Baldé et al., 2024). These figures indicate a gap between the increasing consumption of electronic devices and the capacity of waste-management systems to handle discarded products.

This issue should also be considered within the framework of sustainable development. Sustainable Development Goal (SDG) 12, on Responsible Consumption and Production, promotes more responsible patterns of consumption and production. Target 12.4 calls for the environmentally sound management of chemicals and all wastes throughout their life cycle, while Target 12.5 aims to substantially reduce waste generation through prevention, reduction, recycling, and reuse (Hales & Birdthistle, 2023). In the context of electronic waste, these targets relate both to controlling risks from hazardous materials and to recovering the value of devices and components that remain usable. This study uses SDG 12, particularly Targets 12.4 and 12.5, as an analytical framework to examine the relationship between applicable legal provisions and e-waste management practices. It does not quantitatively measure the achievement of these targets in Medan.

Within Indonesia's legal system, electronic waste management is not governed by a single legal instrument. Its regulatory framework is established through several regulations with different scopes, namely general waste management, specific waste management, and the management of waste containing hazardous and toxic substances and hazardous and toxic waste. Law No. 18 of 2008 concerning Waste Management provides the legal basis for waste reduction and handling obligations. Article 2 paragraph (1) distinguishes between

household waste, household-like waste, and specific waste. Article 2 paragraph (4) letters a and b includes waste containing hazardous and toxic substances and waste containing hazardous and toxic waste as categories of specific waste (Undang-Undang Nomor 18 Tahun 2008 tentang Pengelolaan Sampah, 2008). This classification provides a basis for understanding why not all electronic waste can be treated as ordinary household waste.

Furthermore, Article 12 paragraph (1) of Law No. 18 of 2008 requires every person involved in the management of household waste and household-like waste to reduce and handle waste in an environmentally sound manner. This obligation is related to Article 20 paragraph (1), which provides that waste reduction includes waste generation limitation, recycling, and reuse. Article 22 paragraph (1), meanwhile, regulates the stages of waste handling, comprising sorting, collection, transportation, treatment, and final processing. These provisions establish the general framework for waste management, including the management of electronic equipment once it becomes discarded material (Undang-Undang Nomor 18 Tahun 2008 tentang Pengelolaan Sampah, 2008).

These provisions are further elaborated in Government Regulation No. 27 of 2020 concerning Specific Waste Management. Subsequently, Minister of Environment and Forestry Regulation No. 9 of 2024 provides more operational rules on the management of waste containing hazardous and toxic substances and hazardous and toxic waste. Article 3 paragraph (1) requires every person generating such waste to undertake waste reduction and handling. Of particular importance to this study, Article 3 paragraph (2) letter c expressly includes unused electronic goods as a type of waste containing hazardous and toxic substances. Article 9 further regulates the stages of handling, namely sorting, collection, transportation, treatment, and final processing (Peraturan Pemerintah Nomor 27 Tahun 2020 tentang Pengelolaan Sampah Spesifik, 2020).

On the other hand, hazardous and toxic waste management is further regulated under Law No. 32 of 2009 concerning Environmental Protection and Management, as amended, and Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management. Appendix IX, Table 1 of Government Regulation No. 22 of 2021, concerning the List of Hazardous and Toxic Waste from Non-Specific Sources, includes code B107d for electronic waste comprising Cathode Ray Tubes (CRT), fluorescent lamps, Printed Circuit Boards (PCB), and metal wires, classified as Category 2 hazardous waste. The appendix also lists code A111d for used refrigerants from electronic equipment under Category 1 (Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup, 2009).

These two regulatory frameworks must be carefully distinguished. Minister of Environment and Forestry Regulation No. 9 of 2024 classifies unused electronic goods as waste containing hazardous and toxic substances, whereas Government Regulation No. 22 of 2021 lists certain types of electronic waste as hazardous and toxic waste according to their codes and sources. This distinction is important because the terms waste containing hazardous and toxic substances and hazardous and toxic waste are not interchangeable. The applicable classification and management obligations must therefore be determined by considering the legal status, characteristics, and source of the relevant material (Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 9 Tahun 2024 tentang Pengelolaan Sampah yang Mengandung Bahan Berbahaya dan Beracun dan Limbah Bahan Berbahaya dan Beracun, 2024; Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup, 2021)

Beyond this legal framework, the implementation of electronic waste management is also influenced by local government capacity, business involvement, electronic-device users' behaviour, and the availability of collection and treatment facilities. Previous research has identified challenges in e-waste management in Indonesia in comparison with approaches adopted in other countries (Raharjo & Utomo, 2022). Research on household e-waste generation has also demonstrated the importance of examining the contribution of household activities to the electronic waste stream (Widarti et al., 2024). These findings provide a basis for examining not only the existence of legal provisions but also the extent to which relevant management practices correspond to the applicable regulatory framework.

Although previous studies have addressed comparative e-waste management and household waste generation, further examination is needed of the relationship between Indonesia's environmental law framework and its implementation at the local level. This study addresses that issue by analysing how legal provisions determine electronic waste classification, handling obligations, and government responsibilities, as well as how these

provisions are reflected in practices identified in Medan. Targets 12.4 and 12.5 of SDG 12 provide an additional analytical framework for examining the relationship between the applicable regulations and the objectives of environmentally sound waste management and waste reduction through prevention, reuse, and recycling (Chan et al., 2018).

The empirical component of this study is based on semi-structured interviews with eleven informants, comprising two representatives of the Medan City Environmental Agency, two mobile-phone repair operators, and seven Universitas Sumatera Utara students. Their experiences provide insights into e-waste management practices and related implementation issues, rather than representing the overall condition of e-waste management across Medan. As the study does not involve direct interviews with electronic manufacturers, it does not assess the compliance or effectiveness of individual manufacturers' waste-management programmes. Accordingly, this study focuses on examining the legal construction of e-waste management within Indonesia's environmental law system and analysing the implementation of the applicable legal provisions through practices identified among local government authorities, repair businesses, and electronic-device users in Medan. The analysis further considers the relevance of these practices to SDG 12, particularly Targets 12.4 and 12.5.

2. Method

This study employs a normative-empirical legal research method, combining statutory and conceptual approaches with empirical data obtained through interviews (Benuf et al., 2020; Widiarty, 2024). The normative analysis examines the legal framework governing e-waste management in Indonesia, particularly Law No. 18 of 2008 concerning Waste Management, Law No. 32 of 2009 concerning Environmental Protection and Management, Government Regulation No. 27 of 2020 concerning Specific Waste Management, Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management, and Minister of Environment and Forestry Regulation No. 9 of 2024 concerning the Management of Waste Containing Hazardous and Toxic Substances and Hazardous and Toxic Waste.

Empirical data were collected through semi-structured interviews with eleven informants, comprising two representatives of the Medan City Environmental Agency, two mobile-phone repair operators, and seven Universitas Sumatera Utara students. The interview data were analysed qualitatively by comparing the practices described by the informants with the applicable legal provisions concerning waste classification, reduction, sorting, collection, and handling. The student informants provide insights into electronic waste management from the perspective of electronic-device users and are not intended to represent the wider population of Medan City. SDG 12, particularly Targets 12.4 and 12.5, serves as an additional analytical framework for examining the relevance of the legal provisions and identified practices to environmentally sound waste management and waste reduction (Hales & Birdthistle, 2023).

3. Result and Discussion

3.1 Legal Construction of Electronic Waste Management within Indonesia's Environmental Law System

The legal construction of electronic waste management in Indonesia is established through the interaction of legislation governing general waste management, specific waste management, and the management of waste containing hazardous and toxic substances waste (*Bahan Berbahaya dan Beracun* "B3"). This regulatory framework determines the legal status of discarded electronic goods, the parties responsible for their management, and the stages of handling that must be carried out. Accordingly, electronic waste management must take into account the characteristics, sources, and legal classification of the materials concerned. In this regard, a distinction must be maintained between waste containing hazardous and toxic substances and hazardous and toxic waste, as these categories have different classification criteria and management implications (Paminto et al., 2024).

Law No. 18 of 2008 on Waste Management provides the general legal foundation for waste management in Indonesia. Article 2 paragraph (1) classifies waste into household waste, household-like waste, and specific waste. Furthermore, Article 2 paragraph (4) letters a and b includes waste containing hazardous and toxic substances and waste containing hazardous and toxic waste as categories of specific waste. This classification indicates that waste with particular characteristics requires a management mechanism different from that applied to ordinary household waste. Article 12 paragraph (1) requires everyone to reduce and handle

household waste and household-like waste in an environmentally sound manner. This obligation is elaborated in Article 20 paragraph (1), which identifies waste reduction through waste generation limitation, recycling, and reuse. Meanwhile, Article 22 paragraph (1) regulates the stages of waste handling, comprising sorting, collection, transportation, treatment, and final processing. These provisions provide the general legal basis for managing electronic goods that have become waste in accordance with their applicable legal classification.

The Waste Management Law also regulates government responsibilities and public rights. Articles 5 and 6 place central and regional governments under an obligation to ensure the proper and environmentally sound management of waste. These responsibilities include raising public awareness, facilitating waste reduction and handling, providing facilities and infrastructure, and coordinating with communities and business actors. At the regency and municipal levels, Article 9 paragraph (1) letters b and c authorizes local governments to organize waste management within their respective territories and provide guidance and supervision over waste management activities carried out by other parties. These provisions are directly relevant to the provision of collection facilities and the delivery of waste management services at the local level. In addition, Article 11 paragraph (1) letters a and c grants the public the right to receive proper and environmentally sound waste management services and accurate, reliable, and timely information concerning their implementation (Undang-Undang Nomor 18 Tahun 2008 tentang Pengelolaan Sampah, 2008). At the production stage, Article 20 paragraph (3) of Law No. 18 of 2008 requires business actors to use production materials that generate as little waste as possible, can be reused, can be recycled, and/or are naturally biodegradable. Article 15 also regulates producers' obligations concerning packaging and/or goods they manufacture that cannot be or are difficult to decompose naturally. These provisions form part of the legal framework for waste reduction at the production stage. Their application to electronic products, however, must take account of the scope of the relevant provisions and their implementing regulations.

The regulation of specific waste is further elaborated in Government Regulation No. 27 of 2020 on Specific Waste Management. This regulation governs categories of waste requiring special management mechanisms, including specific waste containing hazardous and toxic substances. In the context of electronic waste, Article 5 paragraph (2) letter c specifically identifies unused electronic goods as a category of specific waste containing hazardous and toxic substances. This provision is significant because it expressly recognizes unused electronic goods within the legal framework governing specific waste management. Accordingly, electronic goods that are no longer used cannot simply be treated in the same manner as ordinary household waste. This classification provides the basis for applying further requirements concerning their sorting, collection, and handling (Peraturan Pemerintah Nomor 27 Tahun 2020 tentang Pengelolaan Sampah Spesifik, 2020).

More detailed provisions on the management of waste containing hazardous and toxic substances and hazardous and toxic waste are stipulated in Minister of Environment and Forestry Regulation No. 9 of 2024 on the Management of Waste Containing Hazardous and Toxic Substances and Hazardous and Toxic Waste. Article 2 paragraph (1) assigns responsibility for managing such waste to the central government, provincial governments, and regency or municipal governments in accordance with their respective authorities. Article 3 paragraph (1) requires every person generating such waste to undertake waste reduction and handling. More specifically, Article 3 paragraph (2) letter c includes unused electronic goods within the category of waste containing hazardous and toxic substances. This provision clarifies the legal status of unused electronic goods and establishes the basis for applying the corresponding management obligations (Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 9 Tahun 2024 tentang Pengelolaan Sampah yang Mengandung Bahan Berbahaya dan Beracun dan Limbah Bahan Berbahaya dan Beracun, 2024).

The regulation also governs waste reduction and handling mechanisms. Article 5 provides for waste reduction through waste generation limitation, recycling, and/or reuse. Article 7 regulates recycling and reuse activities in accordance with applicable requirements, including the business licensing requirements stipulated in that provision. Where waste generators are unable to undertake recycling or reuse, Article 8 provides for the transfer of such waste to a Specific Waste Management Facility (FPSS). Article 9 further establishes the stages of waste handling, comprising sorting, collection, transportation, treatment, and final processing. Sorting obligations are elaborated in Articles 10 and 11. Article 10 paragraph (1) requires sorting to be carried out by individuals at the source and by area managers. Meanwhile, Article 10 paragraph (2) letter c specifically includes damaged and/or unused electronic goods among the types of waste that must be sorted. Article 11 paragraph (2) letter a number 3 further prescribes the use of black-coloured containers for damaged and/or unused electronic goods. These provisions demonstrate that electronic waste regulation not only recognizes its

legal classification but also establishes management procedures from the point at which the waste is generated (Pasific, 2026).

The responsibilities of local governments concerning waste collection are further regulated in Articles 14 and 15 of Minister of Environment and Forestry Regulation No. 9 of 2024. These provisions govern the collection of sorted waste by regents or mayors, including through FPSS. The regulation also addresses the provision of sorting containers at waste management facilities, taking into account the distance to the facilities and the coverage of the service area. This framework demonstrates that local government responsibilities extend beyond guidance and supervision to include the organization of specific waste collection mechanisms. Its implementation requires appropriate facilities, clear collection procedures, and information enabling the public to identify the locations and procedures for handing over electronic waste (Wardiningsih et al., 2026).

The management of hazardous and toxic waste is also regulated under Law No. 32 of 2009 on Environmental Protection and Management. Article 58 addresses obligations concerning the management of hazardous and toxic substances, while Article 59 regulates the obligation to manage hazardous and toxic waste by the parties generating it. These provisions were subsequently amended through Law No. 6 of 2023 on the Enactment of Government Regulation in Lieu of Law No. 2 of 2022 on *Cipta Kerja* into Law. The amendments within the environmental affairs cluster concern adjustments to the instruments for implementing environmental protection and management, including business licensing, government approvals, and hazardous and toxic waste management (Erwin Prasetyo, Bayu Dwi Anggono, 2024). One provision particularly relevant to electronic waste management is Article 59 of the Environmental Protection and Management Law, as amended under the *Cipta Kerja* Law regime.

Article 59 paragraph (1) of the Environmental Protection and Management Law requires every person generating hazardous and toxic waste to manage the waste produced. Where the generator is unable to undertake the management independently, Article 59 paragraph (3) requires the management to be transferred to another party. Furthermore, Article 59 paragraph (4) stipulates that hazardous and toxic waste management must obtain a business licence or approval from the central or regional government in accordance with their respective authorities. This provision confirms that the management obligation is not only imposed on the party generating the waste, but also concerns the requirements that must be fulfilled by the party receiving and managing it. In the context of electronic waste, this provision is relevant where electronic components generated through repair activities or other business operations meet the criteria for hazardous and toxic waste. Transferring components to collectors or other parties does not, by itself, establish that the management obligation has been fulfilled (Prasetyo & Puspitasari, 2024). The legal status of the material, the position of the receiving party, and the applicable management requirements must still be considered.

The amendments within the environmental affairs cluster under the *Cipta Kerja* Law must also be read alongside the provisions concerning environmental approvals and the control of hazardous and toxic waste management activities. However, their application to electronic waste must take into account the type of activity and the legal status of the material being managed. Not every electronic component that is transferred, reused, or handed over to another party automatically becomes subject to hazardous and toxic waste management obligations. Such obligations apply where the material and the management activity meet the criteria and scope prescribed by the applicable legislation. Accordingly, the amendments under the *Cipta Kerja* Law form part of the legal framework governing generator responsibility and the requirements for hazardous and toxic waste management, they do not provide a basis for classifying every unused electronic item as hazardous and toxic waste (*Regulation and Implementation of Hazardous and Toxic Waste in Indonesia*, 2024).

The implementing framework for environmental protection and management is further regulated under Government Regulation No. 22 of 2021 on the Implementation of Environmental Protection and Management. This regulation provides further technical requirements and procedures for hazardous and toxic waste management, including the classification of waste according to its source and characteristics. Appendix IX, Table 1, lists electronic waste under code B107d, comprising cathode ray tubes (CRT), fluorescent lamps, printed circuit boards (PCB), and metal wires, as Category 2 hazardous and toxic waste. In addition, code A111d classifies used refrigerants from electronic equipment as Category 1 hazardous and toxic waste. These classifications provide a legal basis for determining the management requirements applicable to the specified types of electronic waste. However, code B107d cannot be interpreted broadly to mean that every unused electronic device automatically falls within this classification. Classification must take into account the type

and source of waste as prescribed by the regulation (Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup, 2021).

The distinction between waste containing hazardous and toxic substances and hazardous and toxic waste must remain central to the legal analysis of electronic waste management. Minister of Environment and Forestry Regulation No. 9 of 2024 identifies unused electronic goods as waste containing hazardous and toxic substances, whereas Government Regulation No. 22 of 2021 regulates certain types of electronic waste as hazardous and toxic waste according to their classification and source. The legal status of an item cannot be determined solely by its physical form or the fact that it is no longer used. Its status must be assessed by considering whether it has become waste, the activity and source from which it originated, and its conformity with the classifications established under the applicable legislation. This distinction also determines whether the applicable obligations fall under the specific-waste management framework or the technical requirements for hazardous and toxic waste management (*Permen LHK 6/2021 vs 9/2024: Bedah Aturan Limbah dan Sampah B3*, 2025).

At the regional level, the legal framework for waste management in Medan City includes Medan City Regional Regulation No. 6 of 2015 on Waste Management, as amended by Medan City Regional Regulation No. 7 of 2024, as well as Medan City Regional Regulation No. 1 of 2016 on Hazardous and Toxic Waste Management. The regional waste management framework governs waste reduction and handling, including sorting, collection, transportation, treatment, and final processing. Although regional waste management regulations have not established a system specifically dedicated to electronic waste management, the existing provisions may serve as a basis for local governments to organize waste management services, provide facilities, and conduct guidance and supervision. These regional legal instruments must be implemented consistently with the national legal framework, particularly the more specific provisions concerning unused electronic goods and hazardous and toxic waste management (Peraturan Daerah Kota Medan Nomor 6 Tahun 2015 tentang Pengelolaan Persampahan, 2015; Purba, Bonaraja & Angkat Febryanti, 2023).

3.2 Implementation of Electronic Waste Management: Practices and Challenges

The implementation of electronic waste management is examined through the practices described by eleven informants, comprising two representatives of the Medan City Environmental Agency (*Dinas Lingkungan Hidup Kota Medan*), two mobile-phone repair operators, and seven Universitas Sumatera Utara students. The findings indicate that electronic waste is handled differently depending on the role of each party, the condition of the device or component, and its remaining economic or functional value. At the government level, management is primarily associated with the broader framework for hazardous and toxic waste. Repair businesses handle electronic components through storage, reuse, return to customers, resale, transfer to collectors, or disposal. Meanwhile, electronic-device users reported storing, repairing, selling, giving away, or disposing of devices and smaller components. These practices provide a basis for assessing how the legal obligations discussed above are reflected in the implementation of electronic waste management (Prasetyo & Puspitasari, 2024).

Interviews with the two representatives of the Medan City Environmental Agency indicated that waste associated with electronic devices is addressed within the broader framework of hazardous and toxic waste management. According to the informants, businesses generating hazardous and toxic waste are required to provide temporary storage facilities for hazardous and toxic waste (*Tempat Penyimpanan Sementara Limbah* B3 or TPS LB3) and comply with relevant administrative and technical requirements (Purba, Bonaraja & Angkat Febryanti, 2023). These requirements include preparing technical details, providing labels, maintaining logbooks, using manifests, and cooperating with third parties authorized to manage hazardous and toxic waste. The informants also explained that the Environmental Agency conducts guidance and supervision through outreach activities and inspections of waste-management compliance. Supervision may be conducted directly or indirectly and on a routine or incidental basis. However, the implementation of these activities is constrained by the limited number of environmental supervisors, making it difficult to supervise all businesses simultaneously. Where waste management is found to pose a risk of environmental pollution, administrative measures may be imposed according to the nature and level of the violation.

These findings reflect the responsibilities assigned to local governments under Articles 5, 6, and 9 of Law No. 18 of 2008, particularly in ensuring environmentally sound waste management, providing facilities, coordinating with relevant parties, and supervising waste-management activities. They are also consistent with

Article 2 of Minister of Environment and Forestry Regulation No. 9 of 2024, which assigns local governments responsibilities for managing waste containing hazardous and toxic substances and/or hazardous and toxic waste within their respective authorities. The limited number of supervisors reported by the informants indicates an institutional capacity challenge in carrying out these responsibilities. Nevertheless, the available interview data do not establish the overall frequency, coverage, or effectiveness of all supervisory activities conducted by the Environmental Agency. The finding should therefore be understood as a constraint identified by the informants rather than proof that supervision across Medan is ineffective.

An important finding concerns the availability of electronic waste collection facilities. According to the Environmental Agency informants, Medan City does not yet have a dedicated facility specifically intended for the collection of electronic waste. As a result, the management of electronic waste at the local government level remains largely connected to the general mechanisms for managing hazardous and toxic waste, while a collection mechanism specifically directed at electronic waste was not identified in the interviews. This finding is relevant to Articles 14 and 15 of Minister of Environment and Forestry Regulation No. 9 of 2024, which establish local government responsibilities for collecting sorted waste through FPSS. It is also related to Article 11 paragraph (1) letters a and c of Law No. 18 of 2008, which recognizes the public's right to waste-management services and accurate information. The issue is therefore not simply whether legal provisions concerning collection exist, but whether appropriate facilities and accessible collection arrangements are available to support their implementation. The absence of a dedicated facility reported by the informants also raises questions about how residents and businesses can identify appropriate channels for transferring electronic waste for further management.

The interviews with two mobile-phone repair operators revealed that repair activities generate various electronic components, including LCD screens, circuit boards, charger cables, batteries, and other small components. Their handling depends on the condition of the components and whether they retain functional or economic value. Components that can still be used may be stored for future repairs, reused, returned to customers, or transferred to collectors. Certain components, such as LCD screens, may be sold to collectors, while batteries may be taken or purchased by parties interested in them. On the other hand, smaller components considered no longer useful may be discarded as waste. These practices demonstrate that electronic waste generated through repair activities does not follow a single handling mechanism. Instead, the subsequent treatment of each component depends largely on its condition, potential for reuse, and the availability of parties willing to receive or purchase it.

The practices of repairing and reusing components are relevant to Article 20 paragraph (1) of Law No. 18 of 2008, which recognizes recycling and reuse as forms of waste reduction. They are also relevant to Articles 5 and 7 of Minister of Environment and Forestry Regulation No. 9 of 2024, which regulate waste reduction and the reuse or recycling of waste within the scope of that regulation. However, the legal assessment must distinguish between components that remain functional and are still used as parts or spare components, and materials that have already become waste. Once a component has become waste, its subsequent management must be determined according to its legal classification and source. Where a component falls within the hazardous and toxic waste categories listed in Appendix IX to Government Regulation No. 22 of 2021, its management must follow the applicable hazardous and toxic waste requirements. Conversely, an item that remains suitable for repair or reuse should not automatically be classified as waste merely because it has been removed from a device (Paminto et al., 2024; Zulkarnaen et al., 2025).

The transfer of electronic components to collectors represents one of the management practices identified in mobile-phone repair activities. Components that retain economic value, such as LCD screens and batteries, are transferred to collectors through sales or direct collection by interested parties. This practice demonstrates the economic recovery of electronic components that are no longer used in repair activities. However, electronic waste management does not end with the transfer or sale of these components (Purba, Bonaraja & Angkat Febryanti, 2023). Once classified as waste, such components must still be managed in accordance with their legal classification and applicable requirements. Accordingly, the connection between repair businesses, collectors, and waste-management operators plays an important role in ensuring that electronic components requiring specific treatment are properly managed. This finding highlights the need to strengthen the collection and transfer mechanisms for electronic components so that their economic value can be recovered while maintaining environmentally sound waste management practices.

Interviews with seven Universitas Sumatera Utara students revealed several practices concerning electronic devices that were no longer used. Some informants chose to keep old devices because they retained functional or economic value, had personal or sentimental significance, or contained personal data that had not yet been transferred or deleted. Others reported repairing devices, selling them, or giving them to other people who could use them, including for spare parts. These practices indicate that the decision to discard an electronic device is not determined solely by whether it is damaged. Its remaining utility, economic value, personal significance, and the availability of alternative uses also influence how users handle it. In this context, storing, repairing, reselling, and transferring devices may extend their useful life and delay their disposal.

However, the interviews also identified practices that raise concerns regarding the sorting and handling of electronic waste. Some informants reported disposing of smaller components, including charger cables, earphones, flash drives, and batteries, together with household waste. The reasons included the absence of waste-sorting facilities at their residences, the small size of the components, the perception that they no longer had any use, and limited information about appropriate electronic waste disposal (Sari, 2021). Most informants also indicated that they were not clearly aware of the availability of electronic waste collection facilities around the university or elsewhere in Medan and had not used such facilities. These findings are relevant to Article 3 paragraph (2) letter c and Articles 10 and 11 of Minister of Environment and Forestry Regulation No. 9 of 2024, which recognize unused or damaged electronic goods as waste containing hazardous and toxic substances and establish sorting requirements for such waste. The practice of disposing of these items together with ordinary household waste therefore indicates an implementation issue concerning waste sorting and access to appropriate disposal information.

Nevertheless, the reported practices should not automatically be treated as individual legal violations. Such a conclusion would require a more specific examination of the status and characteristics of each item, the circumstances in which the waste was generated, and the legal obligations applicable to the person concerned. This study did not conduct technical testing or classification of every electronic device and component handled by the informants. The interview findings are therefore used to identify practical difficulties in implementing sorting and handling requirements, rather than to establish the legal liability of individual users.

The interviews also revealed limited public awareness of producer responsibilities after electronic products have been used. Although one informant reported having participated in a trade-in programme organized by a producer, the research did not obtain sufficient information about the programme's collection mechanism, the entity responsible for managing returned devices, or the final destination of the products. This experience cannot establish that an integrated electronic waste collection or take-back system is available and commonly used by the wider group of informants. It does, however, illustrate that some users have encountered product-return arrangements, while awareness and access to such mechanisms remain uneven within the research sample. Since the study did not include direct interviews with manufacturers, it cannot assess the compliance or effectiveness of individual manufacturers' programmes (Djafar et al., 2023).

When the findings from the three groups of informants are considered together, several implementation challenges become apparent. First, electronic waste management at the local government level remains largely associated with the general hazardous and toxic waste management framework, while the Environmental Agency informants reported that a dedicated electronic waste collection facility was not yet available. Second, repair businesses handle components through different arrangements depending on their condition and economic value, but the research did not establish a consistent mechanism connecting these businesses with formal collection or treatment facilities. Third, some users continue to dispose of smaller electronic components together with household waste, while awareness of appropriate collection channels remains limited. Fourth, the limited number of environmental supervisors reported by the Environmental Agency presents an institutional constraint in carrying out guidance and supervision. These findings indicate that the central implementation issue is not simply the absence of legal provisions, but the extent to which the existing obligations are supported by accessible facilities, clear information, coordination among relevant parties, and reliable pathways for subsequent waste management (Hakim & Hakim, 2024).

The relationship between these findings and SDG 12 can be examined particularly through Targets 12.4 and 12.5. Target 12.4 calls for the environmentally sound management of chemicals and all wastes throughout their life cycle. In the context of electronic waste, this objective requires appropriate identification and sorting of unused electronic goods, collection through suitable channels, and subsequent handling according to the

characteristics and legal classification of the materials. The provisions of Minister of Environment and Forestry Regulation No. 9 of 2024 concerning classification, sorting, collection, and handling provide a normative basis for this objective. Meanwhile, the listing of specified electronic waste under Appendix IX to Government Regulation No. 22 of 2021 demonstrates the importance of ensuring that materials classified as hazardous and toxic waste are managed according to the applicable technical requirements. The reported absence of a dedicated collection facility, limited public awareness of collection channels, and uncertainty surrounding the subsequent destination of components transferred to collectors indicate practical challenges in connecting these legal requirements with environmentally sound management throughout the waste life cycle (UGM, 2025).

Target 12.5 focuses on substantially reducing waste generation through prevention, reduction, recycling, and reuse. The practices identified among repair businesses and electronic-device users show that repair, reuse of components, resale, and transfer to other users can extend the useful life of electronic products and reduce the need for immediate disposal. These practices are consistent with the direction of Article 20 paragraph (1) of Law No. 18 of 2008 and Article 5 of Minister of Environment and Forestry Regulation No. 9 of 2024. However, reuse and recovery activities must be distinguished from the handling of materials that have already acquired a specific hazardous-waste classification. The potential economic value of an electronic component does not remove the need to comply with applicable management requirements once the material has become waste subject to a particular regulatory regime. Similarly, the disposal of small electronic components together with household waste presents a challenge to waste reduction and environmentally sound handling, particularly where those components should be sorted separately.

The findings therefore show that the relationship between electronic waste management and SDG 12 depends on more than the existence of regulatory provisions or isolated reuse practices. Target 12.4 requires certainty that electronic waste is identified, sorted, collected, and managed through appropriate channels, while Target 12.5 requires stronger opportunities for prevention, repair, reuse, and recycling. The implementation challenges identified in this study point to the need for local government to strengthen public information, improve access to appropriate collection arrangements, coordinate with parties capable of managing waste according to its classification, and maintain guidance and supervision within its authority. Repair businesses and users also need clearer information about the distinction between reusable components and waste that requires specific handling. These measures would help connect the legal framework with everyday waste-management practices and support the objectives of responsible consumption and production (Hanif & & Reza Gufron Akmara, 2025).

The analysis of SDG 12 in this study is qualitative and limited to the practices and legal arrangements identified through the research. Interviews with eleven informants cannot establish whether Targets 12.4 and 12.5 have been achieved in Medan, nor can they determine the overall level of compliance or performance of the city's electronic waste management system. The study does not measure electronic waste generation, formal collection rates, recycling volumes, or SDG indicators. Its findings instead identify the extent to which the applicable legal framework and selected practices correspond to the objectives of environmentally sound waste management and waste reduction, while highlighting the implementation challenges that require further attention.

4. Conclusion

This study finds that Indonesia's legal framework for electronic waste management is established through interconnected regulations governing general waste management, specific waste, environmental protection, and hazardous and toxic waste. Law No. 18 of 2008, Law No. 32 of 2009 as amended by Law No. 6 of 2023, Government Regulation No. 27 of 2020, Government Regulation No. 22 of 2021, and Minister of Environment and Forestry Regulation No. 9 of 2024 collectively provide the legal basis for the classification, reduction, sorting, collection, and handling of electronic waste. The analysis also highlights the importance of distinguishing between unused electronic goods classified as waste containing hazardous and toxic substances and electronic components that fall within the legally prescribed categories of hazardous and toxic waste, as each classification entails different management requirements.

Regarding its implementation in Medan, the findings reveal several practices, including the storage, repair, reuse, resale, and transfer of electronic components to collectors, as well as the disposal of smaller components together with household waste. These practices reflect differences in how local government, repair businesses, and electronic-device users handle electronic waste. However, the implementation of the legal framework

faces challenges, particularly the limited availability of dedicated collection facilities, insufficient public information regarding appropriate collection and disposal channels, constraints in local government supervision, and the need for clearer mechanisms for managing components transferred to collectors. These findings are relevant to SDG 12, particularly Targets 12.4 and 12.5, concerning environmentally sound waste management and waste reduction through prevention, reuse, and recycling. The study therefore demonstrates the relationship between Indonesia's legal framework and electronic waste management practices in Medan, while identifying implementation challenges that remain to be addressed. Its findings are limited to the experiences of eleven informants and do not establish the overall achievement of SDG 12 in Medan.

References

Baldé, A. C. P., Kuehr, R., Yamamoto, T., Mcdonald, R., Angelo, E. D., Althaf, S., Bel, G., Deubzer, O., Fernandez-cubillo, E., Forti, V., Gray, V., Herat, S., Honda, S., Iattoni, G., Deepali, S., Luda, V., Lobuntsova, Y., Nnorom, I., Pralat, N., … Luda, V. (2024). *E-WASTE MONITOR*.

Benuf, K., Azhar, M., Badan, S., Hukum, K., Hukum, F., Diponegoro, U., Hukum, P., & Kontemporer, M. (2020). *Metodologi Penelitian Hukum sebagai Instrumen Mengurai Permasalahan Hukum Kontemporer Jurnal Gema Keadilan Jurnal Gema Keadilan*. *7*, 20–33.

Chan, S., Weitz, N., & Persson, Å. (2018). *SDG 12 : Responsible Consumption and Production*. *November*, 1–24.

Djafar, A. Y., Puluhulawa, F., Puluhulawa, J., Harun, A. A., Hukum, F., & Negeri, U. (2023). *DAMPAK DARI PENCEMARAN LINGKUNGAN AKIBAT SAMPAH ELEKTRONIK DALAM PRESPEKTIF HUKUM LINGKUNGAN*. *2*(6), 1637–1646.

Erwin Prasetyo, Bayu Dwi Anggono, R. R. A. (2024). *Penyederhanaan Perizinan Lingkungan Hidup di Kabupaten / Kota Melalui Undang-Undang Nomor 6 Tahun 2023 Tentang Penetapan Peraturan Pemerintah Pengganti Undang-Undang Nomor 2 Tahun 2022 Cipta Kerja Magister Ilmu Hukum Fakultas Hukum Universitas Jember , In*. *1*(4).

Faris Hadinata. (2024). *The Impact of Information Technology on Modern Societys Lifestyle*. Telkom University. https://bit.telkomuniversity.ac.id/the-impact-of-information-technology-on-modern-societys-lifestyle/

Grechanyuk, E., Student, P., & Ishchenko, V. (2025). *Analysis of data on the generation of waste electrical and electronic equipment Evgeniy*. *16*, 137–150. https://doi.org/10.63341/esbur/2.2025.137

Group, D. (2026). *50+ E-Waste Statistics 2026*. https://dtpgroup.co.uk/insight/50-e-waste-statistics-2025/

Hakim, L., & Hakim, L. (2024). *Changing the E-Waste Management Paradigm : an Innovative Approach with the Electronic Waste-Atm System*. *04*(02), 96–110.

Hales, R., & Birdthistle, N. (2023). *The Sustainable Development Goals – SDG # 12 Responsible Consumption and Production*. 1–10. https://doi.org/10.1108/978-1-80455-840-920231001

Hanif, S. N., & & Reza Gufron Akmara. (2025). *GREEN POLICY UNTUK PENGELOLAAN SAMPAH ELEKTRONIK DI INDONESIA*. https://doi.org/https://doi.org/10.37145/20rf9b19

Paminto, A. R. I. K., Lautetu, L. M., Prayoga, M. B. R., Meyta, R., & Debora, D. D. (2024). *Evaluasi pengelolaan limbah elektronik di Indonesia*. *1*(1), 1–22.

Pasific, U. E. (2026). *TPS Limbah B3 Sesuai Permen LHK No. 9 Tahun 2024 yang Wajib Kamu Tahu*.

Peraturan Daerah Kota Medan Nomor 6 Tahun 2015 tentang Pengelolaan Persampahan (2015).

Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 9 Tahun 2024 tentang Pengelolaan Sampah yang Mengandung Bahan Berbahaya dan Beracun dan Limbah Bahan Berbahaya dan Beracun (2024).

Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (2021).

Peraturan Pemerintah Nomor 27 Tahun 2020 tentang Pengelolaan Sampah Spesifik (2020).

Permen LHK 6/2021 vs 9/2024: Bedah Aturan Limbah dan Sampah B3. (2025). Indonesia Environment & Energy Center.

Prasetyo, D. I., & Puspitasari, E. (2024). *Hazardous and Toxic Waste (HTW) Management Liability in The Perspective of Civil Law*. *3*.

Purba, Bonaraja, N. A. S., & Angkat Febryanti. (2023). *Analysis of Economic Waste Management in Medan City*. *6*(August), 547–553.

Raharjo, S., & Utomo, A. H. (2022). Comparative Study of Electronic Waste Management in Developed Countries and Indonesia. *Andalasian International Journal of Applied Science, Engineering and Technology*, *1*(1), 28–30. https://doi.org/10.25077/aijaset.v1i1.4

Regulation and Implementation of Hazardous and Toxic Waste in Indonesia. (2024). Indonesia Real Estate Law.

Sari, D. P. (2021). Consumer Intention to Participate in E-waste Collection Programs: A Study of Smartphone Waste in Indonesia. *Sustainability*, *13*(5). https://doi.org/10.3390/su13052759

UGM, P. P. (2025). *Ledakan Limbah Gadget dan Tantangan Konsumsi Berkelanjutan di Era Digital*. https://pkp.pasca.ugm.ac.id/2025/11/18/ledakan-limbah-gadget-dan-tantangan-konsumsi-berkelanjutan-di-era-digital/

Undang-Undang Nomor 18 Tahun 2008 tentang Pengelolaan Sampah (2008).

Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup (2009).

Hasil Wawancara Kelompok 5 Hukum Lingkungan Group A Fakultas Hukum USU, tertanggal 29 September 2026.

Wardiningsih, R., Solina, E., & Dewi, R. Y. (2026). *EDUKASI E-WASTE DI SMKN 2 PRAYA TENGAH Article History : May*, 299–309.

Widarti, B. N., Negara, M. A., & Rahayu, D. E. (2024). Analisis Potensi Timbulan Sampah Elektronik Sektor Rumah Tangga di Kecamatan Samarinda Ulu. *Info Teknik*, *25*(2), 187–200.

Widiarty, W. S. (2024). *Buku Ajar Metode Penelitian Hukum*. Publika Global Media.

Zulkarnaen, R., Hilqiya, M., Andini, R. I., Sari, S., & Harimurti, W. (2025). *Kajian Urgensi Undang Undang Pengelolaan Limbah Elektronik Upaya Mewujudkan Net Zero Emision*. *2*(November), 72–84.